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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE SCOPE AND METHOD OF STATE NATURAL HISTORY SURVEYS[1]

IT is a matter of common knowledge that before the middle of the last century many of the states of the union had established state surveys, and the national government was exploring the great west, fixing boundaries, locating routes and trails, and mapping the physical features in those vast areas. In both state and national surveys, geology received a large share of attention, but physiography, zoology and botany were not neglected. Many of the states, after making a recognizance of the geological features, identified and listed their plants and animals, as did the states of Maine, New Hampshire, Massachusetts, New Jersey, Ohio and Indiana. A condition to be noted in the establishment of a number of these early state surveys is that they were organized for the purpose of exploring and studying all of the natural resources of the commonwealth, scientific as well as economic. The survey of Michigan was established at the admission of the state to the union in 1837 as geological, zoological, botanical and topographic. The prevailing idea in these early surveys in the various states seems to have been what we may designate by the word *recognizance,* including geology, physiography, botany and zoology.

As the century continued through its third and entered its fourth quarter, the main attention of the state surveys became

[1] Address of the vice-president and chairman of Section G, American Association for the Advancement of Science, Cleveland, December 31, 1912.

more and more centered in things concerned with mineral wealth; surveys that formerly had included natural history became restricted to geology, and the geology was often confined to economic studies, so that more than one geologist found himself subject to censure because he wasted his time on such supposedly worthless things as fossils. However, there was a great diversity among the states in the scope of the work they tried to do; and some of them published occasionally a volume on plants and animals. One of the best of such publications is the botany of California, appearing in 1880, the work on which was done by Brewer, Watson and Gray. This is a description of species with notes on habitat and range; but the most of the botany and zoology of this period is mere lists of species, as far as state surveys are concerned.

Special note should here be made of the survey of New York, which is the only example known to the writer that from the first has continued its natural history studies.

It is evident from what has been said that 30 years ago natural history had been largely eliminated from state surveys. In recent years, however, there seems to be a slight tendency to replace this work in the state survey. It is true that the number of states adding natural history to their work within the past quarter of a century has been small, only the states of Connecticut, Wisconsin, Michigan and North Dakota; but the surveys of New York, Illinois and Minnesota have shown renewed activity in natural history within this period, and the activity of agencies outside of official state surveys may be taken as an indication that other states will soon be persuaded to resume this work. These agencies include universities, colleges or museums that are doing some work without order from the state, like the state museums of New Jersey and Louisiana; academies of science, like those in Indiana, Illinois and other states which have started surveys, some of these academies having their work published at state expense; volunteer associations, like the Botanical Seminar of Nebraska and the recent association of universities and colleges of Ohio; and, finally, individuals, like Pammel in Iowa, Hitchcock in Kansas, Nelson in Montana, Bray in Texas and Ramaley in Colorado, who contribute papers on the biogeography of their respective states, sometimes as bulletins of the institutions with which they are connected, sometimes as reports of academies, sometimes as a gratuitous paper in a geological survey.

Though we may feel encouragement over the awakening of interest in natural history, the present condition of the survey work in this subject in most of the states must be regarded as very unsatisfactory. Only 7 states are conducting continuous and systematic natural history surveys, and the most of the work done by outside agencies is more or less haphazard and sporadic. State academies seldom have funds enough to plan any large undertaking, and their future income is not sure enough to allow the laying of plans for a series of years. Men in colleges who may have started surveys give up their positions, and the work stops. Moreover, the scattering of the reports of surveys through several serials, official surveys, college bulletins, and academy reports, is not to be commended. Suppose one should wish to learn what had been published on the botanical survey of Ohio; in how many different publications would he have to search?

What is here said must not be interpreted as condemning state survey work outside of the official surveys. I am not

ignorant of the immense amount of valuable work that has been done by these volunteer agencies, work that would be still undone if it had waited for the call of the state. What a happy conjunction of ability, disposition and means was that in Nebraska which resulted in the "Phytogeography" of that state! A brilliant effect not repeated elsewhere. Also one recalls the valuable papers dealing with state vegetation in Vermont, New Jersey, Iowa, Kansas, Colorado and Texas, all done in recent years outside the official surveys. Success of this kind usually depends on the ability and activity of one or a few spirits whose mantles do not descend on their followers in office.

Besides their value to science, these efforts of individuals, academies, and other non-governmental organizations to contribute to state surveys have the valuable effect of stimulating and promoting interest in such matters till such time as the state will establish and conduct surveys at state expense. The establishment of the Biological Survey in Michigan in 1905 was the direct result of the efforts of the Michigan Academy of Science put forth for the preceding ten years.

There are probably few states in the union whose governing bodies have not been appealed to within the last quarter of a century for funds to undertake natural history surveys; and yet, in spite of all this effort, only four states within this period, to the best of the writer's knowledge, have responded with any considerable financial support—the states of Wisconsin, Connecticut, North Dakota and Michigan. The states of New York, Illinois and Minnesota began their natural history surveys before this quarter-century, and have continued them with fairly generous support.

Seeing that so many of the state governments have been appealed to for aid, and only seven are lending any considerable support, the conclusion is inevitable that the appeal has not strongly interested the governing body; or, to reduce the matter to terms of practical politics, the appeal has not aroused sufficient backing to move state executives and legislatures. What have been the terms of this ineffective appeal? Here let the writer call upon his own experience, while believing that his own experience has been that of many others.

The appeals for state aid have generally recited three classes of benefits to be enjoyed by the state from state natural history surveys. These three are classed as economic, scientific and educational. Taking a leaf from the uniformly successful experience of geological surveys, the natural history promoters have first of all argued for the economic good to the state to come from a natural history survey, in the way of better knowledge of agricultural lands, the promotion of forestry, the increase of fish and game, the discovery and combating of plant and animal diseases, etc. Although this argument has been strengthened by reference to the profitableness of the fish and game industry of Maine, by depicting the sad state of the cut-over forest lands which the survey might remedy, and by numerous other citations, the legislators seem never to be sure that the argument applies to their own state; or, they are not sure that the benefits will not come without the cost of a survey.

The trouble with the argument for economic good seems to be that it is too vague to be convincing. The state geologist in asking for his appropriation proposes to explore a district for iron or copper, or to make a report on water-power or artesian waters. Local or corporate interests force

the matter through the legislature. The committee from the academy of science in presenting to the legislature its claims for a natural history survey, unlike the geologist, seldom has a definite promise of a definite task to be performed whose conclusion will be of economic interest to the state. It may be that some advocates have the ability to convince a legislative committee of the economic value to the state of a natural history survey; but it is certain that the most of the advocates of the past have not been so highly gifted.

The second argument usually employed in furtherance of a natural history survey pertains to the benefit to be enjoyed by science. The legislators have been reminded that the pride and patriotism of the state require that she should do her part toward building the great structure on which New York and Illinois are so faithfully laboring. On this argument the scientific advocate would like to dwell; but he realizes, at least he does after a little experience, that it is one of the least effective. The legislator counts on his fingers the scientists he knows in the state, and decides to risk their displeasure.

If it be conceded that, as a means of moving legislatures, the argument for economic benefit is weak because vague; and the argument for promoting science is ineffective because the class specially interested is small; what may be expected from the third argument most often used—the benefit to education, the benefit to the schools of the state?

In attempting to answer this question, it may be said that there are several conditions favorable to the use of this argument. The number of people in the state directly or indirectly interested in the work of the schools is very large. This large body is constituted by the better educated and more intelligent citizens, and therefore one of the most effective classes of citizens. Again, the active members of this body are organized, extending from the state department of education to institutes, associations, clubs and circles, all of which could easily be reached if their influence was desired.

Some one now offers the suggestion that this proposal contains nothing not already tried, and that its use in the past has brought few results, seeing that but a paltry half-dozen states are at present conducting natural history surveys. I will readily admit that the argument has been unsuccessfully tried in several or many states within the past two decades. But I wish also to say that in my own state, Michigan, I believe it was the argument of educational benefit, more than any other, which resulted in the establishment of the biological survey in 1905. We appealed for aid in passing the bill to scores of teachers, and to several teachers' organizations. I wish also to say that the argument for educational benefit usually contains the same weakness that pertains to the argument for economic benefit: it is vague because it does not have definite tasks to propose, definite things that the survey will surely do for education. It is true that several of the reports or bulletins on biological matters, issued within the past twenty years by the state surveys of Minnesota, Wisconsin, Connecticut, Michigan and New York, are as much or more for educational as for scientific purposes. But, to my mind, the most of these are not convincing examples of the benefits which a survey can give to the schools. The most of them can not be used by the schools, either because they are not written so as to be used or they cover so large a territory that they arouse no local interest. These reports are not written wholly for science; for their descriptions and illustra-

tions are for many species little more than repetitions of what the scientist is familiar with elsewhere. Such publications therefore, are not very satisfactory illustrations of what a survey can do for the schools, either to the advocates of a bill before a legislature or to the school instructors whose aid may be sought for the bill. And if such productions seem unsuited to the purpose to those who are working for the bill, how shall these advocates employ these reports to show what the proposed survey may do? But can the argument for a state natural history survey be strengthened by holding up for its aim a definite, worthy and vote-compelling task, just as definite as the proposal of the geologist to explore an iron range?

The plan for a natural history survey which seems to me most likely to bring legislative consideration in the largest number of states, a survey which, if once started, will carry with it all that is desired for education, economics and science, is that of a *regional survey,* biogeographic in its nature, the reports of which should be so written as to be intelligible and useful to scientists, citizens and school children alike.

The method of regional surveys within a state is not new. New York uses it for the geological survey, making the unit-regions the quadrangles of the U. S. Topographic survey; and Maryland uses it, making the county the unit-region. The biogeographic method is now made to include not only flora and fauna with their distribution but also climate, topography, soil and general relation to environment. This biogeographic method of survey was used among the first by Professor Flahault, of Montpellier University, in France, and was later applied by R. Smith to survey the region about Edinburgh, and still later by Messrs. G. Smith, Moss and Rankin for Yorkshire, England. In our own country similar attempts have been made by the Botanical Seminar in Nebraska, by Hitchcock in Kansas, by Livingston in two counties in Michigan, and by the Geological and Biological Survey of Michigan in the bulletin of 1911, entitled "A Biological Survey of the Sand Dune Region of the South Shore of Saginaw Bay, Michigan." This list names but a few of the attempts at biogeographic survey work, some of which have been noted successes, while others have had inadequate publication facilities. The method has been tried and found feasible. It was used by Schimper in his "Pflanzengeographie," in Spalding's "Distribution and Movements of Desert Plants," and is now in use in the making of that excellent series under the editorship of Engler and Drude, "Die Vegetation der Erde."

A regional, biogeographic survey requires maps on which to spread data of distribution and habitat. Fortunately for the purpose, good base maps are already provided in the topographic survey of the government. Every state in the union has had a considerable portion of its area thus mapped in quadrangles of 20 to 50 or more miles square, and these maps are covered with contour lines giving just what is needed for the spreading of biogeographic data.

Conceive that a survey party goes into one of these quadrangles provided with a topographic map, that the work of the survey eventuates in a report on the phytogeography and the zoogeography of the region, that distribution data are spread on the topographic maps, that climate, soil and other physical features are given, and finally that all parts are so presented that the reading of the report and the study of the region will put the intelligent reader into possession of what that quadrangle

contains in the way of natural features and the influence of these features upon one another, and we have, it seems to me, the best kind of a natural history survey to which the state could devote its efforts.

One good report of this kind, made for a judiciously chosen quadrangle, or fractional quadrangle, would put a powerful weapon into the hands of those who are fighting for the establishment or the continuance of natural history surveys. If the report was successfully written so that it could be used by the school teachers and the schools, the advocates of a survey bill before the legislature would have a proposition just as definite in its promise as any geologist could offer for his work. If state academies of science, or other bodies who are working for the establishment of surveys, could, by their own efforts, produce one such report as a sample, it seems to me they would be able to present the strongest possible argument for the state to continue the good work, and they would find plenty of support on the part of the schoolmen and schoolwomen. Let me cite an illustration from my own state: Michigan is among the most backward in appropriating money for cooperation with the federal government in the making of the topographic survey. While some states have nearly all of their area mapped, and many states have more than a half mapped, Michigan has only fifteen to twenty quadrangles mapped. New maps have been added slowly and those interested in the survey have had to fight for every appropriation. But the people of the unmapped areas have at last discovered what these maps mean, and from various parts of the state calls for maps will be sent to the legislature just convening. So certain are the members and friends of the Geological Survey that the request for funds for topographic work will for the future take care of itself, that for the first time they will make no effort in its behalf.

So, it would seem, may it be with the natural history survey. We have tried to use the argument of financial benefit, and it has not worked. We have tried the argument of the benefit to science, and it has not worked. The trouble with the first argument seems to be that we have not and we can not clearly define the work we would do so as to be reasonably sure of pecuniary returns. The weakness of the second argument is that relatively so few citizens would be benefited. The argument for educational benefit has met with little better success than the others, but this is probably owing to lack of definite plan. There is herewith proposed a definite plan which is believed would find supporters numerous enough to be influential. This method of doing the work, even in state surveys, has been practised by Adams, Ruthven and others in this country. I am urging the adaptation of the plan for the benefit of the schools of the state, believing that it can be made the strongest possible argument for the state survey.

Suppose such a biogeographic regional survey to be in operation, and suppose the reports to be so written up and the maps to be so made that the schools could use the reports for guides in the study of the geology, geography and natural history of the region, such a treatment of the survey would also furnish guides for all that increasing number of citizens who like to study nature. The benefits to these classes of our population, the young people in the schools, and the citizens who like the outdoors, would justify the survey. But there are other benefits that would follow: The survey could be planned so as to furnish data for instruction in agriculture and forestry and other applied sciences.

This biogeographic regional survey

would have all the scientific value attaching to the taxonomy, geography and ecology of such work. But besides this, such a survey would be the very best means of discovering the special problems that should always form a part of a state survey. There has been no intention in what has been said here to limit the work of the natural history survey to the surveyed quadrangles of the Topographic Survey. Rather, it seems to me, should this be adopted as the general policy of the survey; and, if successfully done, it could be made to carry the other scientific work of the survey. Important problems in morphology and physiology would arise, and sometimes the survey would wish to explore a region sparsely inhabited, the report of the work in which would not be of immediate use to the district, but might be of great value to science.

There are still two benefits to be mentioned which I believe would follow the adoption of the biogeographic regional survey. The first is the stimulation to investigation within the state in natural science, including natural history. This stimulation would produce better work as the result of opening up multitudes of problems on distribution, habits, etc. An increase of activity in the study of scientific problems of the state would tend to produce more valuable contents both for the survey reports and for the reports of the academies of science. We might even hope to see the lists of algæ from Bermuda and the crayfish from Yucatan crowded out of these reports by the press of work done in the state.

The second benefit to follow, incident to the awakening of scientific interest in the state by the phytogeographic and the zoogeographic survey, and the problems discovered by these surveys, would be the strengthening of the state academies of science, and the better understanding and sympathy among scientific workers, and between scientific workers and teachers of science. Many of us know how hard it is to make the state academy of science a worthy and profitable institution; we know how hard it is to obtain interesting matter for the annual programs. On the other hand, we know how many teachers out in the state would gladly participate in work on some problem. Cooperation between the state survey and the academy of science offers a means for many people of some scientific ability, but not specialists, to engage in profitable work. Some of this work can be used by the survey and some by the academy of science. The survey and the academy of science should be closely allied, and generously critical of one another.

As to the organization for a state natural history survey, I have nothing to give except a word of advice to those who have to start the work with but a small appropriation. Undoubtedly it would be best to have a specialist at the head of each scientific department represented; but if the annual fund is but a thousand or two, this is out of the question. But if the fund is only a thousand dollars annually, it is better to spend half of it in the employment of a director for part time, than to attempt to direct the work by a committee. The survey needs continuity of thought and purpose and a good deal of drudgery such as a committee is not likely to perform. If the reports or bulletins are designed for educational purposes as well as scientific, see that the written matter is presented so as to be capable of the use for which it is intended; much good matter has been buried by a bad presentation. It is not of the first importance that at the very start of the new survey the time-honored desig-

nation of "Geological Survey" should be changed to "Geological and Natural History Survey." Some legislators are fearful of the change. The important thing is to get an appropriation and start work. If a good start is made and the survey shows its desert, the change in title can come later.

In summarizing, I will but mention the few points I have tried to emphasize in this paper:

1. With but seven states in the union supporting natural history surveys, the present condition of such work the country over is unsatisfactory.

2. Though efforts have been made to induce numerous states to establish natural history surveys, such efforts have been attended with but little success.

3. The probable cause of failure lies in the difficulty experienced by the promoters of such surveys in stating definite and important results that the survey will accomplish.

4. The suggestion is made that if the plea for a natural history survey propose a biogeographic regional survey whose reports can be used as guides for study by the schools, the proposal will be definite and the object such as to interest a large body of supporters.

5. To make these reports serve the purpose of scientific treatises as well as guides to the study of natural history and biogeography, special care must be used in the organization and presentation of the material in written form.

6. The successful preparation of local guides for the study of natural history, phytogeography and zoogeography will enable the survey to carry on other scientific work.

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Recent Legislation Affecting Educational Institutions in Kansas

The state of Kansas, through its legislature which has just closed its biennial session, has finally decided to enter upon what may appeal to many as a doubtful experiment in educational administration, although it is hoped that a step forward has been taken. Essentially, the new arrangement consists in the application of the commission form of government, somewhat modified, to all of the state supported educational institutions.

Two years ago a bill to place the state university, agricultural college and normal school under one board of administration was passed. It will be recalled that Governor Stubbs at that time obtained the opinion of many prominent educators and administrators as to the probable success of the plan. Finding that there was almost a unanimous sentiment against this method of university administration, the governor finally vetoed the measure.

The present state officials were elected on a platform which pledged them to a reform measure which would place all higher educational institutions of the state under a single board. The motive for this change is a desire to secure a more efficient, and at the same time less expensive, administration, in that costly duplication of work in three separate institutions might be avoided without decreasing the efficiency or impairing the present high standards of all the institutions. In addition, it is believed that such a plan should lead, if properly carried out, to a better cooperation of all the parts of a complex educational system.

The act to bring about the centralization of authority in the management of the large state institutions was passed by the legislature, and signed by the governor on February 11. This measure includes the following institutions which are all placed under a single board of three members: The State University of Kansas, with the school of mines at Weir City; The Agricultural College at Manhattan, with its experiment stations located at Hays City, Dodge City, Garden City and Colby; the Normal School at Emporia, with the Manual Training Normal at Pittsburgh and the Nor-

mal School at Hays City; the Kansas School for Deaf at Olathe, and the Kansas School for the Blind at Kansas City. Even this list may not be complete, as the branch schools have been scattered generously over the state. The members of the board are to receive a salary of $3,500 each per year for their services.

An attempt to prevent political prejudices is found in the provisions which require that at least two political parties be represented, and that not more than one alumnus from any given institution may sit at the same time, on the board. Furthermore, the members must all be chosen from different congressional districts. Tenure of office as a member of the board is for four years, the appointments being made in such a way that the board can not be completely changed at any one time, except in case of disqualification and suspension by the governor.

The board is given a large hand in the management of the affairs of the institutions, being given power to elect the presidents and treasurers, to appoint all professors, instructors, officers and employees; to fix the salaries which shall be paid, and to make all rules and regulations for rank and promotion of the faculty and employees. Apparently the whole administrative policy of the institutions is placed in their hands, the presidents being merely their executors and advisers. The management of all the property, execution of all trusts, the direction of the expenditure of all appropriations, and the investment of funds received by legacy and otherwise, are also vested in this single board.

The board, which will have its central office at Topeka, will assume charge on July 1, 1913. The commission is required to visit each institution at least monthly, and to make reports from time to time of the needs of the institutions which they control for the state.

The members of the commission appointed by Governor Hodges are Ex-governor E. W. Hoch, well known as editor and lecturer; Mrs. Cora G. Lewis, who has been prominent as an organizer of school employment bureaus, and who is well known for her literary attainments; and Edward T. Hackney, of Winfield, a graduate of the University of Kansas of 1895, and a prominent lawyer. The governor seems to have succeeded admirably in a difficult task. There is general agreement that the board is well fitted for the labors devolving upon it, and the friends of all the institutions are looking forward to a larger development under the new leadership. If an optimistic outlook makes for success in these matters, then the Kansas experiment should justify the high hopes entertained for the future.

Kansas has been exceedingly unfortunate in separating all of its educational institutions, and in pursuing the policy of scattering branch schools over the state for political reasons. It is impossible for the student who desires the advantages of the several schools to enjoy the privileges of all of them at once, as in the majority of states where at least agricultural college and university cooperate in education without duplication of forces and instructional staffs. In Kansas such a form of cooperation has been rendered impossible from the outset by the establishment of the institutions many miles apart. Wise foresight would have made the present conditions impossible. In no case have the agricultural colleges or state universities succeeded so well separately as when situated so that active cooperation and conjunction of forces are possible; and it remains to be seen whether the creation of a State Board of Administration of Educational Institutions can remedy a fundamental and irretrievable mistake in educational policy.

Those who have thus far guided the institutions will cooperate with the new board most heartily, and with singleness of purpose will seek to make the departure in administration successful from its inception. If carried out in the right spirit, this attempt at correlating and unifying the educational work of the state may result in very great advantage to all the interests concerned. The results of a somewhat different plan in Iowa have been far from satisfactory to any of the institutions. Of course, it is hoped and believed

by the optimistic people of Kansas that similar results will not be obtained here.

The *logical* outcome of this new movement in Kansas would perhaps be a gradual merging of the interests of all the state schools, and the realization of a greater University of Kansas. The *actual* outcome will be watched with more than usual interest by every one who has at heart the problems of efficient and liberal university administration.

Charles A. Shull
The University of Kansas

Scientific Notes and News

Dr. Hugh M. Smith, deputy commissioner of fisheries, has been appointed United States fish commissioner.

The Chicago Section of the American Chemical Society has elected Dr. Leo H. Baekeland, of Yonkers, N. Y., to be the recipient of the Willard Gibbs medal, founded by William A. Converse. The first award was made in 1911 to Professor Svante Arrhenius, director of the Nobel Institute, at Stockholm, Sweden. The second medalist was Professor Theodore W. Richards, of Harvard University. The formal presentation of the Willard Gibbs medal will be made to Dr. Baekeland at the May meeting of the Chicago Section of the American Chemical Society. The jury of award which selected Dr. Baekeland comprised Professor Alexander Smith, Dr. W. R. Whitney, Dr. E. C. Franklin, Professor W. A. Noyes, Dr. J. D. Pennock, Professor G. B. Frankforter, Professor John H. Long, Professor Julius Stieglitz, Mr. William Brady, Mr. E. B. Bragg, Mr. S. T. Mather and Dr. G. Thurnauer.

The American Philosophical Society at its stated meeting on April 19 elected the following members: Dr. George F. Atkinson, professor of botany and head of the botanical department of Cornell University; Dr. Charles Edwin Bennett, professor of the Latin language and literature in Cornell University; Dr. John Henry Comstock, professor of entomology and invertebrate zoology in Cornell University and non-resident professor of entomology in Stanford University; Luther P. Eisenhart, professor of mathematics in Princeton University; George Washington Goethals, U.S.A., chief of engineers of the Panama Canal; William Crawford Gorgas, Assistant Surgeon General, U.S.A., member of the Isthmian Canal Commission; Dr. Ross Granville Harrison, professor of comparative anatomy, Yale University; George Augustus Hulett, professor of physical chemistry in Princeton University; Dr. Clarence Erwin McClung, professor of zoology, University of Pennsylvania; John Dyneley Prince, professor of Semitic languages in Columbia University and president of the House of Representatives of New Jersey; Dr. Samuel Rea, president of the Pennsylvania Railroad Company; Dr. Henry Norris Russell, professor of astronomy at Princeton University; Witmer Stone, curator of ornithology of the Philadelphia Academy of Natural Sciences. Three foreign members were elected as follows: Sir Arthur John Evans, keeper of the Ashmolean Museum, Oxford; Sir Joseph Larmor, Lucasian professor of mathematics at Cambridge; and Dr. Arthur Schuster, professor of physics at the University of Manchester.

The Lobachevsky prize of the Academy of Sciences of Kasan has been awarded to Professor F. Schur, of the University of Strassburg, for his researches in the foundations of geometry.

The University of Edinburgh will confer the degree of LL.D. on the Hon. James Wilson, lately secretary of agriculture of the United States.

Dr. Alexis Carrel and Dr. Hideyo Noguchi, of the Rockefeller Institute, Dr. H. M. Biggs and Dr. William H. Park, of the New York Department of Health, and Dr. John W. Brannan, of Bellevue and allied hospitals, have been made knights of the Royal Order of Isabella the Catholic by King Alfonso of Spain.

Dr. Thomas N. Carver, of Harvard University, has been appointed by Secretary

Houston to take charge of the proposed "Rural Organization Service," a new branch of the Department of Agriculture, designed to aid the farmer in economic, social and cooperative buying and selling.

PROFESSOR FICKER, for many years assistant at the Berlin Institute of Hygiene, has been given leave of absence, so that he may take charge for one year of the bacteriologic institute at São Paulo, at the request of the Brazilian government.

PROFESSOR HEDINGER, of Basel, has been appointed director of the Königsberg Institute of Pathologic Anatomy, succeeding Professor Henke, who has been called to Breslau.

DR. A. J. CHALMERS, of Ceylon, known for his work on the etiology of pellagra, has been appointed director of the Wellcome Research Laboratories at Khartoum in succession to Dr. Andrew Balfour, who has been appointed director in chief of the Wellcome Bureau of Scientific Research in London.

PROFESSOR THOMAS C. CHAMBERLIN, head of the department of geology in the University of Chicago, and Professor Forest R. Moulton, of the department of astronomy and astrophysics, are members of a special committee of the Illinois Academy of Science appointed to recommend a revision of the present Julian calendar.

PROFESSOR CHARLES E. VAN BARNEVELD, of the school of mines of the University of Minnesota, has been offered an appointment as chief of the department of mines and metallurgy for the Panama-Pacific Exposition to be held in 1915.

DR. G. M. WHIPPLE, assistant professor of educational psychology, has been appointed as the delegate of Cornell University to the Fourth International Congress on School Hygiene, to be held at Buffalo on August 25–30 next.

DR. JOSE M. RUA, professor of biology in the University of Buenos Ayres, is visiting the universities of the United States.

THE three selected candidates for the vacant professorship of astronomy in Gresham College, London, are Mr. F. W. Henkel, Mr. A. R. Hinks, secretary of the Royal Astronomical Society, and Mr. E. W. Maunder, superintendent of the Solar Department at the Royal Observatory at Greenwich. They will each give a probationary lecture before the Gresham Committee.

DR. H. M. W. EDMONDS, of the Department of Terrestrial Magnetism of the Carnegie Institution, will head an expedition to Hudson Bay designed to secure magnetic data in the region between the Albany and Severn rivers. A special attempt will be made to locate, as accurately as possible, the focus of maximum total intensity in North America, supposed to be in the vicinity of Cat Lake, near latitude 52°.2 N. and longitude 92° W. The expedition will leave Washington in May and is expected to return in October of this year.

GEORGE B. RIGG, instructor in botany in the University of Washington, and special agent of the U. S. Department of Agriculture in kelp investigation in 1911 and 1912, is in charge of an expedition to western Alaska for the purpose of investigating the kelps of that region as a source of potash fertilizer. It is expected that a good deal of the work will be in the vicinity of Kodiak Island and the Shumagin Islands. The power halibut schooner *Gjoa* has been chartered for the trip. This expedition is sent out by the Bureau of Soils and is a continuation of the work that Dr. Frank Cameron has been directing during the past two years. The other members of the party are: Professor Robert F. Griggs, of the Ohio State University, and Mr. Sanford M. Zeller, graduate assistant in botany in the University of Washington. Dr. T. C. Frye, professor of botany in the University of Washington, is in charge of a similar expedition to southern Alaska. With him are Dr. Robert B. Wylie, professor of botany in the University of Iowa, and Mr. Dean Waynick, a student at the University of Washington. The gas boat *Zarembo* has been chartered in Seattle for the trip. Both of these expeditions will leave Seattle on May 1.

The Maryland University School of Medicine is offering a course of twenty lectures on tropical medicine under the supervision of Surgeon J. A. Nydegger, of the U. S. Public Health Service, with the assistance of Dr. C. W. Stiles, Dr. H. R. Carter, and other members of the Public Health Service.

"The Business of Agriculture in the College Curriculum" was the subject of an address to the students of the college of agriculture of the University of Illinois, given by Dean Price, of the Ohio State University, on April 11.

Dr. Lester F. Ward, professor of sociology at Brown University, and formerly paleontologist of the U. S. Geological Survey, died in Washington on April 18, in his seventy-second year.

The death is announced, on April 7, at sixty-nine years of age, of Mr. F. G. Smart, fellow of the Linnean and the Royal Geographical societies.

Dr. Georg Boehm, honorary professor of geology at Freiburg, has died at the age of fifty-nine years.

Dr. John Seemann, director of the physiological laboratory of the Academy of Medicine at Cologne, has died at the age of forty-nine years.

Professor H. Alexan Bezjian, Ph.D. (Yale, '74), teacher of physical science in Central Turkey College, Aintab, Turkey-in-Asia, died suddenly of arterial sclerosis, on February 10, 1913, in his seventy-sixth year. He was one of the most distinguished scientific men that Turkey has yet produced. His early training was received at Bebek Seminary, Constantinople, under Dr. Cyrus Hamlin, though he was born and brought up in Aintab. Except for two years spent in America in preparation, and a later year spent in France and England, he taught almost continuously in Aintab, and the neighboring city Marash, for fifty-six years. For thirty-seven years he was the senior member of the faculty of Central Turkey College, and he was in active service at the time of his death, always abreast of the times, eager for the latest news or to learn of the freshest discovery. He was the author of many newspaper articles, and of books on "Natural Religion" "Guide to the Study of the English Language" (in Armeno-Turkish and English and the first book of its kind in Turkey), and "Elements of Physics." This latter book was published simultaneously in Armenian and in Armeno-Turkish. The Armenian form is now in its second and revised edition.

A vacancy at present exists in the position of chemist, qualified in physical chemistry, in the Bureau of Standards, Department of Commerce, at Washington, D. C. This position requires a high order of scientific training, equivalent to that required by the leading American universities for a professorship in physical chemistry. The government seeks a man with a thorough and broad scientific education and several years' experience, and he must possess qualifications of a very high order in the theories of physical chemistry and their applications. He must be qualified to act as adviser in all fields where a knowledge of physical chemistry is required, and be capable of initiating and carrying out researches in the field of the bureau's varied activities. Ability to take a broad view on chemical subjects is essential. The entrance salary for this position is $3,500 a year. The government is endeavoring to find the best man available for this work. The method of selection will be similar to that of an educational institution or business organization whose trustees or governing officers desire to fill a professional or technical position. The qualifications and fitness of applicants will be passed upon by a board containing men of recognized eminence in chemistry. Candidates will not be assembled for examination, but will be rated with respect to their education and training, their technical and professional experience, and their achievements as shown by publications and results accomplished. Persons interested should write to the United States Civil Service Commission, Washington, D. C. Letters of inquiry must be received by the Commission prior to May

15, 1913. Efforts will be made to reach a decision on this appointment by June 1, 1913.

THE U. S. Civil Service Commission announces an examination for associate physicist, qualified in metallurgy, to fill a vacancy in the Bureau of Standards, Washington, D. C., at a salary of $2,200 a year. There is also announced an examination for logging engineers to fill vacancies in this position in the Forest Service, Department of Agriculture, at salaries ranging from $2,400 to $3,000 a year. The duties of this position will be: (1) Planning the most effective logging development of large national forest areas; (2) determining methods and costs of logging and manufacturing national forest timber and the market value of the products; (3) appraising the value of stumpage for sale; (4) inspecting and supervising the administration of timber sales.

THE Fourth International Congress on School Hygiene will be held in Buffalo, August 25 to 30. The officers are Dr. Charles W. Eliot, president; Dr. William H. Welch and Dr. Henry P. Walcott, vice presidents; Dr. Thomas A. Storey, of the College of the City of New York, secretary general, and Dr. Francis E. Fronczak, the Buffalo member of the executive committee. Delegates will attend from all the leading nations, from every college and university of note in this country and from various other educational, scientific, medical and hygienic organizations.

THE following provisional program of the Australian meeting of the British Association in 1914 is published in *The Observatory:*

July 3—Leave London by direct steamer (later by overland route).

August 4—Arrive Freemantle (for Perth), Western Australia. An advance part leaving England a week earlier than the main party will join the main party here.

August 8–12—Adelaide. Lectures; receptions; excursions.

August 13–19—Melbourne. Presidential address (first part); sectional meetings, etc.

August 20–26—Sydney. Presidential address (second part); sectional meetings, etc.

August 28–31—Brisbane. Lectures; receptions; excursions.

The earliest date of arrival in England is October 3; the route is by train to Adelaide, thence by steamer (*viâ* Suez to a Mediterranean port). Returning by steamer *viâ* Thursday Island, Port Darwin, Java, Singapore and Colombo, members will reach England about October 10–18. A party visiting New Zealand for a week will probably arrive home about the end of October.

UNIVERSITY AND EDUCATIONAL NEWS

WILLIAM B. REED, JR., whose death occurred recently in Putnam County, N. Y., has left an estate estimated at $350,000, of which $250,000 is left to Princeton University, subject to the life interest of his wife.

BY the will of Addison Brown, ex-judge of the United States District Court, who died on April 9, Harvard University receives, $10,000; Amherst College, $5,000; Bradford Academy, $5,000, and 200 shares of United States Steel preferred are left to the New York Botanical Garden.

MR. JOHN HOWARD FORD has given $1,000 to Rutgers College for the purchase of the entomological library of the late Professor John B. Smith.

ON May 8 and 9 the University of Illinois will dedicate three new engineering buildings. These are the transportation building, the locomotive testing laboratory and the mining laboratory. A series of addresses by eminent men in the transportation and mining fields will be features of the program.

THE mayor of Dresden has published a pamphlet in which the plan for the foundation of a university in that city is described. The university is to be combined with the already existing technical and veterinary colleges. It is proposed that the city appropriate $2,500,000 (10,000,000 Marks) for this purpose, and the state a sum of $75,000 for the erection of buildings and an annual appropriation to defray the expenses of the scientific departments.

The educational bill providing for five scholarships in each assembly district of New York state has been signed by Governor Sulzer. Each holder of a scholarship will receive from the state $100 a year for four years to be applied toward the payment of the annual tuition fee charged by the college selected, which must be within the state. Scholarships will be awarded on the basis of school standing, and when they are all filled there will be 3,000 students at one time receiving state aid.

The Sheldon traveling fellowships of Harvard University have been awarded in the sciences as follows: Donald Clinton Barton, Cambridge, for research in geology in Europe and Egypt during the summer; Sidney Fay Blake, for research in botany in Europe; Elmer Keiser Bolton, for research in chemistry at Berlin; Richard Maurice Elliott, for research in psychology, particularly in the psychophysics of handwriting, at Berlin and in the various psychological laboratories of Germany; Harvey Cornelius Hayes, instructor in physics, for travel in the United States, between September and February, for the purpose of observing the manufacture of alloys; Sidney Isaac Kornhauser, for research in zoology at Würzburg and at the Naples Zoological Station; Edward Hale Perry, for travel in the mining districts of the United States during the summer of 1913; Joseph Slepian, for research in mathematics in Europe, and Paul Dudley White, for research in pharmacology at London and Strassburg.

The governing body of the Royal School of Mines, which is an integral part of the Imperial College of Science and Technology, London, are about to appoint a new professor of metallurgy in the room of Professor W. A. Carlyle, who is resigning in order to resume his professional work.

Professor Edward L. Nichols, of the department of physics of Cornell University, has been appointed dean of the College of Arts and Sciences.

Martin John Prucha, of Cornell University, has been appointed assistant professor of dairy bacteriology in the College of Agriculture of the University of Illinois, and assistant chief in dairy bacteriology in the Agricultural Experiment Station. He will be associated with the new head of the dairy department, Dr. A. H. Harding.

DISCUSSION AND CORRESPONDENCE

CONVENTIONAL POSITION OF MONOCLINIC CRYSTALS A QUESTION IN CRYSTALLOGRAPHIC USAGE

To the Editor of Science: So much of individual preference, not to say caprice, has in the past attached itself to crystallographic nomenclature and convention that it seems desirable, before introducing further innovation, to get the opinion of as many interested persons as possible as to the ultimate usefulness of any proposed change. For this reason the writer is asking space in Science, which probably reaches more of our scientific men who come in contact with crystallography than any other single publication, in order to test an idea as to the most desirable setting of crystals belonging to the monoclinic system.

It is suggested that the ortho-axis, which is customarily placed in horizontal position, be set vertically.

The objection at once presents itself that a change from the older long-established setting would necessitate restatement of the crystallographic data concerning all monoclinic substances.

It is, moreover, possible that familiarity with the ordinary types of animals has so accustomed the mind to thinking of a single plane of symmetry in vertical position that advantage should be taken of this facility of thought in presenting to students the somewhat analogous configuration of monoclinic crystals. That this argument should not be given too much weight, however, is evidenced by the fact that beginners of their own accord not rarely place the plane of symmetry of monoclinic crystal models in horizontal position, even after they have recognized the absence of other symmetry planes.

In favor of the proposed change may be cited the following arguments:

1. The conventional usage, already prevail-

ing in the tetragonal, hexagonal and orthorhombic systems, might be made general, viz., that when only one axis of symmetry is present this is set as the *vertical* axis.

2. That diameter which alone is distinguished from all those adjacent to it by its unique character would receive the unique treatment of vertical location, as is now the case in the tetragonal and hexagonal systems.

3. The lateral axes would, with this setting, be distinguished as the macro- and brachy-axes, as in the orthorhombic and triclinic systems. Every teacher realizes what a store of mental energy this would set free for more profitable application than its present task of keeping in their proper places the prefixes clino-, ortho-, macro- and brachy-.

4. The familiar spherical projections which Groth has used to show the kinds of crystal symmetry, and which are now widely used, would then have the same relative position in the monoclinic as in the other systems.

5. The failure of positive forms to occur in the upper front right octant could be obviated by placing acute β at the right of the observer, thus removing another unnecessary stumbling-block from the path of the learner.

The undersigned would be very glad to see an expression of opinion by any interested readers as to the desirability of making this change in the conventional position of monoclinic crystals.

A. C. GILL

CORNELL UNIVERSITY,
March 26, 1913

QUOTATIONS

UNIVERSITIES AND INTELLECT

THIRTY-SEVEN years ago next fall Johns Hopkins University was opened, upon an endowment estimated at less than $3,500,000. Yesterday, it was stated that the budget adopted by the trustees of Columbia University for the expenses of the coming academic year amounted to $3,450,000. The foundation of the University at Baltimore was widely acclaimed as an event of the highest importance and the most hopeful augury. Never before had the income of so large a fund been placed at the disposal of the trustees of any new American institution of learning; and the Johns Hopkins trustees had, in the choice of its president, and in the announced plans of the institution, made it plain that their opportunity was to be so used as to give to the higher intellectual life of the country a great and long-needed stimulus. The hope was entertained that the new university would be the means of introducing in America what had so long been vainly desired by scholars and scientists—the true university, in the European sense of the term. And that hope was not disappointed. The foundation of Johns Hopkins University marked the beginning of a distinctly new era in the history of higher education in America. What had formerly been the rare pursuit of a devoted scholar here and there has become the regular occupation of thousands of students in scores of colleges and universities. In many a field of research our country now makes contributions which, in point of quantity and sometimes also in point of quality, stand well alongside those of the leading nations of Europe; whereas, before the new start made in 1876, it was only some unusually gifted or ardent mind that went beyond the mere acquisition of the results of foreign learning and investigation.

In compassing with what would now be regarded as small means so signal an achievement, one cardinal feature of the policy pursued by President Gilman and the Johns Hopkins trustees was essential. There was one thing to which every effort was directed, every energy bent—the securing of the highest possible quality in the professors. A small group of real intellectual leaders formed the nucleus of the faculty; and in adding to them younger men in the various departments the keenest interest was constantly maintained in the discovery of unusual talent or exceptional attainment. Those who were at the university in its early years testify unanimously to the extraordinary exhilaration and inspiration of the atmosphere thus created. The buildings were extremely modest, and in large part of a makeshift character, being old residences altered at slight expense; the warning given by Huxley, in his notable address at the open-

ing, against putting into bricks and mortar what ought to be invested in brains, was rather by way of accentuating a policy already pursued than of advising its adoption. The revenue from the endowment proved to be even less than had been expected; much, it was felt, had to be done in the way of ordinary collegiate instruction to meet the needs of time and place; and if, with the means available for the distinctive purposes of the university, so great an impetus was given at Baltimore to the university idea in America, this must be ascribed, above all else, to the clear recognition of the prerogative of intellectual superiority as the one touchstone of university distinction.

The Columbia budget of $3,450,000 is typical of the present-day expenditures of our larger universities. That they accomplish great results, results of extensive and varied usefulness, no one would deny. They cover a field much larger than that which formerly comprised the activities of our institutions of learning. They do much to promote civic enlightenment, and assist concretely in the solution of many problems of government. But we doubt whether any one would so much as claim that the enormous enlargement of university expenditure has been attended with any such nourishment of high intellectual standards or ideals as might have been hoped. Indeed, many a man may be tempted to compare in this respect the big and rich universities of to-day with the struggling institutions of half a century ago to the decided disadvantage of the present. The roster of the faculty becomes ever longer and longer; but how many of the names are such as it will thrill the students to recall thirty or forty years hence? There is always danger, in such matters, of the illusion of fond memory; the shining names of teachers under whom students were proud in after years to recall that they had sat were never very numerous. Still, it ought to be possible, out of the thick volume of professors' names in the catalogue of any of our leading universities, to single out a goodly list of those whose eminence is unmistakable and impressive, whose influence counts as a great intellectual or spiritual force, whose presence gives to the university significance and dignity, to the enjoyment of whose instruction or inspiration the student will look back in after years as a never-to-be-forgotten privilege. Some such there are; but, in comparison not merely with an ideal possibility, but with what is actually found in foreign universities, they are extremely few and far between.

In comparison with this question, all matters of mere "management" are trivial. And it is for this reason, more than any other, that we have always regarded the magnifying of questions of administration in our American universities as so deplorable. To get men of real power into the professorships—that is the great problem. The question of salaries is undoubtedly a great stumbling-block; though even here the magnifying of administration adds to the difficulty, for a due recognition of the paramount importance of the professor would naturally tend to the making of such salaries as are needed to render professorships fairly attractive in a material sense. But important as this material side is, even more important are the less tangible elements that fix the character of the professorial life. These can not be had, indeed, simply by taking thought; the slow growth of tradition, and the temper of the national life as a whole, are preponderating factors. But we may help the growth of the tradition; and we may modify the influence of the national temper on the subject, for better or worse. As far back as Tyndall's visit to this country, in the early seventies, the British scientist took occasion to exhort his American audiences to prevent such waste of scientific genius as he found going on here, as illustrated in the case of Joseph Henry, abandoning physical research for administrative duties. We must make the life of the scholar and scientist attractive not merely in point of salary, but in point of honor, of leisure, of sympathetic environment; and all other tasks of university presidents and university trustees are of small moment in comparison.—New York *Evening Post*.

SCIENTIFIC BOOKS

The Eurypterida of New York. By DRS. JOHN M. CLARKE and RUDOLF RUEDEMANN. New York State Museum Memoir No. 14. Albany. 1912. 2 vols.

This handsome memoir, illustrated by 121 text-figures and accompanied by an atlas of beautifully engraved plates, marks a notable addition to the series of special monographs published by the New York State Educational Department, the importance of which from a purely scientific standpoint can not be overestimated. Granted that a knowledge of the wonderful world we live in and of the manifold variety of life inhabiting it is of value for its own sake, even though it yields no direct material returns, there can be no question that the publication of this series of memoirs has contributed largely toward the advancement and diffusion of knowledge, in which respect the empire state long ago took the lead and has set a worthy example for sister commonwealths to emulate.

The new monograph before us is of a character such as might be expected of two authors who are recognized as holding front rank among invertebrate paleontologists. Not merely is this one of the regular contributions of trained specialists, valuable though it is as a great storehouse of facts. It is something more besides. Those familiar with the group of organisms considered must acknowledge it to be a philosophic essay which bears the stamp of authority, since everywhere one finds that conclusions have been reached only after mature deliberation, upon rigorous analysis of the evidence (often complex and confusing), and in the light of all previous researches that have been conducted in this difficult field.

As is befitting a scholarly production, the memoir is embellished by a graceful literary style, in which lucidity and directness of expression are conspicuous elements. Hugh Miller at his best could not have employed a more appropriate and smoothly flowing phrase, though he may have unwittingly inspired it, for we find his name bestowed upon one of these peculiar-looking creatures which in the parlance of Scotch quarrymen are called "seraphim."

This volume represents the fruition of long-cherished plans, and more than fifteen years of patient collecting, preparation and study of an immense quantity of material. In localities formerly productive of good specimens but now no longer worked, nothing was thought of tearing down and rebuilding many rods of stone wall and foundations of old barns, on the chance of securing a bit of fresh evidence, or of following up a single new clue. In point of diversity, the thousands of specimens which passed under scrutiny during the preparation of this memoir exceed all other collections in the world. Little wonder, therefore, that so exhaustive an investigation should have yielded important new results and thrown a flood of light upon the structure and relations of this extinct order of merostomes. In fact, the organization of eurypterids has probably been studied in greater detail than that of any other group of fossil animals, and our precise knowledge of them is comparable with that which we have of recent arachnids. The theme is a fascinating one, and touches closely on human interests when we consider the theory, recently revived in some quarters, of the arachnid origin of vertebrates.

The general thesis of the book is that eurypterids, the king crab and other merostomes are arachnids, and share a common origin with the scorpion and its allies. As for the scorpions, to which a special section is devoted in the appendix, it is worthy of note that they exceed all other animal forms of high elaboration in point of racial longevity, having had a continuous existence from the Silurian onward.

A very important chapter is that which is devoted to a comparison of the anatomical structure and larval stages of development as observed in eurypterids, *Limulus* and scorpions. The conclusions reached from this line of research are: (1) that "the limulids and eurypterids were probably separate in pre-Cambrian time"; (2) that "neither *Limulus* nor the scorpions are derivable from the

eurypterids, but that all three, while related, have early separated, and that eurypterids are still nearest in their general aspect to this common ancestor"; and (3), while we have no clue as to what this common ancestor was, it is clear that the earliest and most primitive known crustacea (trilobites) do not stand in that relation, and therefore the derivation of various types of these arachnids from arthropods more primitive than the crustaceans seems a necessary inference. It is recalled in this connection that Bernard derives the crustacea from a bent carnivorous annelid, and that Beecher regards this view as partly confirmed by his discoveries concerning the ventral anatomy of trilobites.

For the study of the ontogeny of eurypterids the authors had at their command an unrivaled series of larval stages of four genera, ranging in size from a length of 2 mm. or less up to the adult condition. A comparison of growth stages leads to the important conclusion that there is a "general parallelism in the ontogeny of the eurypterids and *Limulus.*" Not less brilliant and far-reaching is the discovery that the Cambrian genus *Strabops* fulfills tolerably well our conception of a generalized prototype from which Silurian eurypterids have descended. The adult *Strabops* so closely resembles the young of later genera as to justify the statement that eurypterids actually pass through a "*Strabops* stage" during their nepionic development. Herein is found fresh evidence in favor of the so-called recapitulation theory, or biogenetic law, as important in its way as the recognition of the "*Prestwichia* stage" of *Limulus*, and the goniatitic and ceratitic stages of ammonites.

Confirmatory evidence in favor of the homologies between eurypterids and king crabs is found in the fact that *Pterygotus* and *Limulus* show a remarkable identity in structure of the compound eyes. The view of their common relationships thus receives strong support from a new body of facts, for, as shown by Watase and others, the visual organs of *Limulus* form an extremely peculiar structural type. Among the various special anatomies that have been minutely investigated, those which have to do with the compound eyes and genital appendages are particularly commendable, and the results gained are of signal importance.

The special essay on morphology and anatomy, together with the discussion as to the mode of life of these creatures, are replete with new and interesting details. Owing to limitations of space, we can only refer to these in the most casual way, and it must suffice to note merely the captions of some of the subordinate themes discussed, as, for instance, the following: Geological distribution and bionomic relations; mode of life; taxonomic relations; synoptic table of North American eurypterids. These lead up to the principal chapter, consisting of 232 pages, which is devoted to a systematic account of the group and is in every way most excellent. After this follows an appendix of 40 pages, in which are set forth the results of investigations and discoveries made since the body of the work went to press. Besides the valuable note on Silurian scorpions, already referred to, there are considered here the relations of several problematical forms, *inter alia* the pre-Cambrian bodies called *Beltina*, the genus *Hastimima* of White, and the suborder *Limulava* of Walcott. Appendices as important as this are welcome in any work for the choice nuggets of new truth they contain.

The greater part of this memoir necessarily deals with the concrete facts of observation and their adjustment to the present state of our knowledge. Nevertheless, an undercurrent of ideas appears to run through various passages, sometimes only suggested or hinted at, or again included within broad generalizations. And the central thought that informs these ideas proves to be an insistence upon the *fundamental human interest of the theme.* For really, is not the general theme one which involves questions concerning our own remote ancestry? And who knows whether we may not discover landmarks which shall point for us the way taken by advancing creation in its slow march through the ages, the end whereof is man? A gradual progression leading up to

man, that mite, that mere atom, that ephemeral fragment of nature! How insignificant a goal; and yet, strange paradox, that mite and that atom is able to comprehend nature, and great enough to know his own littleness. Alone among earth's creatures this being has intelligence fine enough to perceive that his thought is everything, even though it be "but a flash in the midst of a long night"; and even though all life be "only a short episode between two eternities."

Reflections of this sort must certainly have inspired the minds of the authors when writing many pages of this memoir; and in the reviewer's judgment the work has suffered nothing in consequence. Not long ago one Anatole France wrote a natural history of penguins. It is a capital work, and has opened our eyes to new and alluring possibilities of ornithology. But in the preface the author lays down certain rules for the guidance of fellow naturalists if they would greatly extend human knowledge and leave imperishable monuments behind them. Now assuredly Drs. Clarke and Ruedemann have done these things, as this memorial witnesses, yet they have gone exactly contrary to rule. Whence we infer that the learned academician must have been mistaken, for surely no one will accuse him of ever being ironical.

C. R. EASTMAN

CARNEGIE MUSEUM,
PITTSBURGH, PA.

Palæolithic Man and Terramara Settlements in Europe. By ROBERT MUNRO. New York, Macmillan Co. 1912. Pp. 507. Price $5.50 net.

"This volume contains the Munro Lectures in Anthropology and Prehistoric Archeology for 1912, being the first course since the lectureship was founded," in the University of Edinburgh. It seems especially fitting that the eminent archeologist after whom these courses are named should himself be the first to fill that lectureship. A standard is given which is of the highest and which, we may hope, subsequent lecturers will strive to maintain.

Those who are not in the small circle of prehistoric archeologists are prone to look upon their work askance, if indeed they do not ignore it altogether. "Early Bronze is a good enough term for articles in a museum," they say, "but it does not suggest a spiritual being. We can not get on terms of spiritual intimacy with the Early Bronze people. For all their flint arrow-heads, or bronze instruments, we can not think of them as fellow men." These prevalent views can come only from a distorted perspective, a perspective in which only the dull unrelated side of these things is open to our vision—when we see them as objects rather than as evidences. It must be confessed that the specialist is often more than indirectly responsible for this prevalent attitude. To Dr. Munro we must feel grateful for a masterful treatise which, without neglecting the minutiæ and details, subordinates them to their true place in a scheme of wider relations. His facts are evidences, his evidences appear in their proper place in the larger *Culturgeschichte*. We can not be too grateful that, to use his own phrases, "the gnawing tooth of time" has allowed us to rescue from the "dustbins of ages" these few pages of an early history which archeological finds furnish.

The volume is divided into two parts, the first treating of Anthropology: Paleolithic Man in Europe, with supplementary chapter on the Transition Period, the second with Prehistoric Archeology: Terremare, and their Relation to Lacustrine Pile-structure. The volume covers a ground which no other English one duplicates, that of Sollas being more closely related to the first part, and that of T. E. Peet to the second.

Of the first part we have only two criticisms: A map showing the locations of the various described sites would add greatly to the value of the exposition, and a chapter dealing with the methods of burial would have been a valuable addition. The excellent maps incorporated in the author's *Lake Dwellings of Europe,* have their counterpart in the second portion of the present work, which deals with the Po Valley, and there is a chap-

ter devoted to methods of burial—not, however, giving us such valuable information in this regard as we obtain from Peet.

The author is concerned in the main with description, there being no less than 74 full-page plates in addition to the 174 figures. These excellent illustrations greatly enhance the value of the volume. We may regret that the author has not brought the problems out more sharply. The more important of his solutions of the problematic are probably these:

Pithecanthropus erectus represents a type, not necessarily intermediate between man and the monkeys, but one in which the erect posture had been assumed though the head-form of *Homo sapiens* had not completely evolved—"the seeming difference being due to the different standpoints from which the phenomena are contemplated." A *hiatus* between the paleolithic and neolithic in England must be assumed, the so-called mesolithic forms being incomplete neoliths; it is probably to be accounted for on the assumption that paleolithic man was driven out by the cold and the glaciers, to take refuge with the cave-men of France with whom he could easily communicate over the land now covered by the English Channel. Likewise, paleolithic man of Jersey could so communicate. The dual cultures found in the eastern and western parts of the Po Valley, respectively, are explained on the supposition that "the terramaricoli in their migration southwards took possession of these native villages, and lived in their hut-habitations, finding them as comfortable as their own pile-structures. If there was an emigration of terramara folk from Emilia to south Italy, who ultimately became the actual founders of Rome, surely they must have left some traces of their journey behind them. If so, what are these traces? To me the answer is not far to seek: they are scattered along the Adriatic slopes in the numerous hut-villages and cave-dwellings, which are described as containing unquestioned remains of terramara civilization." To this the classical archeologist will retort: *If there was such an emigration.*

The chapter describing Structures Analogous to Terramare in Other European Countries is most welcome, for we do not have a substitute in English.

The volume will appeal both to specialists, who will find it valuable for references, illustrations and descriptive material, and to the lay reader who wishes to have in easy, comprehensive form the latest results in European prehistoric archeology.

W. D. Wallis
University of Pennsylvania

The Cotton Plant in Egypt. By W. Lawrence Balls. Macmillan & Co. 1912. 202 pages, 1 plate and 71 text figures.

The purpose of this book, as announced in the preface, is to abstract "the results of a series of researches made upon cotton plants in Egypt, which investigations, though diverse, were connected by the desire to know all that could be learned about the plant itself." The subject matter covers a wider range than is usual in books concerning cultivated plants. Morphology, physiology and genetics are treated in turn and the bearing upon agricultural practise of each phase of the investigations is constantly emphasized.

An "historical" chapter deals with the perplexing problem of the origin of the Egyptian type of cotton. Professor Balls champions the view that the existing varieties are "more or less heterogeneous complexes of heterozygotes." They are, it would appear, descended from fortuitous crosses of a brown-linted tree cotton of the Peruvian type, long existent in Egypt, with other varieties, among them probably American Sea Island, which was introduced there during the first half of the last century.

Brief accounts are given of the process of fertilization, of the development of the embryo and of the cytology of the fiber. One of the most interesting portions of the work deals with the influence of physical factors, especially temperature, light and soil moisture, upon growth and development. The author distinguishes two periods in the ontogeny of the cotton plant, the first beginning with

germination and the second with the appearance of the first flower. He believes that development is controlled during the earlier period mainly by air conditions, especially temperature, and during the second period mainly by soil conditions, especially water content. He regards as the limiting factor for growth what he terms "thermotoxy"—the supposed accumulation of injurious products of metabolism caused by high temperatures and aggravated by a deficient water supply. Varietal differences in length of the growth period would indicate corresponding differences in resistance to "thermotoxy." Experiments are described which deal with the effect of a high water table in checking root development and in inducing shedding of the flower buds. This subject is at present much discussed in Egypt in connection with the recognized deterioration of the cotton crop.

In the field of genetics fluctuation, natural crossing and heredity are treated. Much space is devoted to the application of Mendelian and post-Mendelian principles to cotton hybrids. This discussion, interesting and suggestive though it be, will scarcely inspire the cotton breeder with confidence that his practical problems will be speedily solved by the Mendelists.

By way of criticism, attention may be called to a certain lack of balance in the space devoted to different phases of the subject. Thus the morphology of the vegetative organs, which is of great interest agriculturally as well as botanically, receives but scant notice. One reads with astonishment that there is "apparent identity of all the modern varieties of Egyptian cotton in external appearance—for, even when grown side by side, they are scarcely distinguishable." Several of the varieties, when grown in Arizona from imported seed, have proven readily distinguishable by the characters of the leaves, bracts and bolls. There is also a tendency to put forth rather sweeping generalizations. Such are the assumptions, regarding fluctuation, that in a pure strain it "is the result of slight irregularities in a normally uniform environment" (p. 89) and that "physiology explains it" (p. 90). It is also not very clear to the uninitiated why transmitting power "is not a mysterious vital function" merely because it "can be reduced to formulæ." Several of the text figures are left without satisfactory explanation, either in the legends or in the text, and the reader would be saved time and trouble if the pages were cited in referring to the figures.

Nevertheless this little volume can not fail to be helpful and suggestive to all investigators of the cotton plant and not its least valuable mission is to show some of the ways by which scientific investigation of a crop plant may be brought to bear in improving agricultural practise.

T. H. K.

Naturwissenschaftliche Studien am Toten Meer und im Jordantal. Von Professor Dr. MAX BLANCKENHORN. Berlin. 478 pages with geographical map and table.

Students of the geology of Palestine probably owe more to Dr. Max Blanckenhorn than to any other one author. The present volume is an account of his last expedition undertaken in 1908 at the request of the Turkish government. The ex-sultan, Abdul Hamid II., apparently desired to discover mineral wealth in the valley of the Jordan River and Dead Sea, which is his private property. Dr. Blackenhorn, however, wisely insisted that the expedition should be primarily scientific, and not economic. The results justify his position, for Palestine is very poor in mineral wealth. Pure science, however, did not satisfy the Turkish government which still, in spite of repeated promises, owes Dr. Blanckenhorn twenty-five hundred dollars for expenses incurred at their request.

Dr. Blanckenhorn's work divides itself into three closely related parts, economic, geologic and physiographic. In respect to the first two we accept his results without question, but as to the third there is some doubt. Inasmuch as the geological formations of Palestine are almost entirely cretaceous, little mineral wealth is to be expected. The salt deposits of Jebel Usdum at the south end of the Dead

Sea would have some value if they were not so inaccessible. The same is true to a greater extent of the phosphatic rocks of cretaceous age which the author describes near Nebi Musa, east of Jerusalem, and near Es-Salt, in Moab, east of the Jordan. These latter deposits are estimated to have a market value of nearly a million and a half dollars, and perhaps much more. Nevertheless, an English company, after spending $20,000 in prospecting, abandoned its enterprise, because the deposits are so remote, and because the directors of the Mecca railway imposed such onerous conditions of carriage. The only other valuable mineral product is asphalt, with which the cretaceous strata are largely impregnated, but the quality is not high, and the arid climate, rough topography and distance from the railroad prevent its exploitation at present. In discussing all these formations —salt, phosphates and asphalt—the author's geological observations are of more value than purely economic considerations.

Throughout the volume Dr. Blackenhorn devotes himself mainly to strict geology. Unfortunately he has adopted the style of a diary in which his birthday, his bath, Turkish officials and the weather are mixed up with a great mass of minute geological details. These details are arranged according to the chance order in which he happened to see them, and hence are difficult to follow and to interpret in general terms. They serve, however, as a running commentary upon two highly valuable contributions, namely, an admirable and reliable geological map, a large part of which is Dr. Blanckenhorn's own work, and a table which sums up the pliocene and pleistocene history of Palestine. The portions of this table based upon physiographic evidence are the part of the volume open to question. A summary of late geological history as interpreted by Dr. Blanckenhorn is as follows:

Lower Pliocene, or late Miocene. Low stand of Mediterranean Sea. First upheaval of the highlands of Palestine, accompanied by east–west, or N.W.–S.E. faulting which gave rise to such features as the separation of Upper and Lower Galilee, the basin of Asochis in southern Galilee, and the fault-scarp and plain of Esdrælon between Galilee and Samaria.

Upper Pliocene. Broad encroachment of sea in Syrian Desert. Small lakes occupying parts of the present area of the Sea of Galilee. Basaltic lava flows of Banias and el-Markab. Completion of first great erosion-phase of rivers.

Gunz Glacial Epoch. Level of Mediterranean Sea 330 meters higher than now. At the beginning of this epoch the depression occupied by the Jordan Valley, Dead Sea, Gulf of Akaba and Red Sea began to take form, while at the end occurred the great movements which gave final form to the deeply depressed graben in which lie these various bodies of water. With this went considerable faulting in a N.E., S.W. as well as N. and S. direction. Conglomerates and marls were deposited in the much-expanded predecessor of the Dead Sea.

Gunz-Mindel Interglacial Epoch. This was a short dry period during which the Dead Sea contracted so far that the thick salt beds of Jebel-Usdum were deposited.

Mindel Glacial Epoch. Sea 33 to 80 meters higher than now. Culmination of glacial period with small glacier in Lebanon. Highest stand of Dead Sea, which extended from the Sea of Galilee to Wadi Araba. The strand formed at this time is supposed by Blanckenhorn to be represented by what he calls the Haupt Terrasse or Terrace of Jericho. In the Jordan Valley he assigns to this a height of 100 to 200 meters above the present level of the Dead Sea, at the north end of the Dead Sea a height of 50 meters, and at the south end a height of 486 meters. His natural inference is that there has been an unequal upheaval at the north and south, and a sinking in the middle. It seems impossible to accept this view, since, as the reviewer has shown in "Palestine and its Transformation," there are terraces at the north end of the Dead Sea much higher than 50 meters; and near the head of Wadi Kuram, in this same region, between Massaba and Nebi Musa, deposits, apparently of lacustrine origin, are found at a height of approximately 450 meters.

Mindel-Riss Interglacial Epoch. A long, dry period during which the Dead Sea fell to approximately the present level. Great erosion and much outpouring of lava.

Riss Glacial Epoch. Slight encroachment of the Mediterranean Sea, many lava flows. Slight expansion of the Dead Sea, formation of the

"middle terrace" in the deltas of various wadis. On physiographic grounds it seems to the reviewer open to question whether this terrace should be put at this time or much later.

Riss-Würm or last Interglacial Epoch. Mediterranean Sea at present level, climate approaching that of to-day.

Würm Glacial Epoch. No notable expansion of the Dead Sea. Formation of lowest terrace of the valleys, a conclusion which is open to question.

Post-Glacial Epoch. Uniform prevalence of conditions like those of to-day.

In the interpretation of rock geology, Dr. Blackenhorn is an expert, but when it comes to the interpretation of such physiographic phenomena as strands and terraces we are unable to accept his conclusions. In the first place he has failed to observe a large number of lacustrine strands which close study reveals at many points and at many altitudes around the Dead Sea. In the second place, he seems to have confused lacustrine and alluvial terraces in various places, and in the third place he has correlated terraces which apparently have no relation to one another. For instance, on page 139, when describing the Araba south of the Dead Sea, he describes a "Haupt Terrasse" with a height of 4 meters and a "Mittel Terrasse" with a height of one meter. The first of these terraces is assumed to have existed ever since the Mindel glacial epoch, and is correlated with a terrace which elsewhere is 150 meters high. He supposes the middle terrace to have originated during the Riis Glacial Epoch, and to have survived the vicissitudes of the Riis-Würm Interglacial Epoch, the Würm glacial epoch, and the succeeding period during which the climate is supposed to have remained in its present condition. Both of these terraces, it must be remembered, are in unconsolidated gravelly alluvium. It seems to the reviewer that they probably are the result of late post-glacial climatic pulsations.

In view of the diversity of results obtained by Dr. Blackenhorn and by other observers the whole question of the history of the Dead Sea from tertiary times onward needs a far more thorough and systematic examination than it has yet received. This is the more necessary since the Dead Sea and Jordan Valley contain one of the best of all records of the Pleistocene history of the drier portions of the world. Dr. Blackenhorn's excellent study of the fundamental rock structure of the region is an admirable basis for such an examination. It is to be hoped that a further step may soon be taken and that by means of a careful instrumental survey of the old strands, terraces and deposits, the physical history of the region during the last hundred thousand years or so may be conclusively determined.

ELLSWORTH HUNTINGTON

SPECIAL ARTICLES

THE PERFECT STAGE OF CYLINDOSPORIUM ON PRUNUS AVIUM

IN the fall of 1910, at the suggestion of Professor George F. Atkinson, the writer began a study of *Cylindrosporium,* as it occurs on species of *Prunus* in the region of Ithaca, N. Y., in order to discover the life history, and the relationship of the organism on the different hosts.

Several sweet cherry trees, which had been severely attacked by *Cylindrosporium* during the previous summer, were noted and the fallen leaves observed at intervals for the appearance of an ascogenous fungus. Early in March developing fruit bodies were noticed in abundance on many leaves, some of which were brought into the laboratory and placed in a moist chamber. After a few days at the room temperature of the laboratory many of the fruit bodies showed mature asci.

Subsequent observations showed that a stroma begins to develop under the *Cylindrosporium acervuli* about the last of August. About the time of leaf fall the acervulus is cut off from the underlying stroma by a compact layer of host tissue two or three cells thick, of thick-walled cells which surrounds the whole stroma and very soon turns black. Slow internal development of this stroma continues during the winter; and by the first of May mature asci and ascospores may be found.

Ascospores were taken from these fruit bodies and placed in drops of water on the leaves of *Prunus avium* seedlings in the greenhouse. This was repeated several times and resulted in every case in abundant infection, followed in a few days by typical *Cylindrosporium* acervuli. Later pure cultures were obtained from the ascospores, and the inoculation tests were repeated, using pure cultures, with similar results.

The study of the life history, relationship, etc., of the fungus is being continued, the results of which will be published in the near future.

The fungus belongs clearly with the Phacidiaceæ and is apparently an undescribed species of *Coccomyces*. The fruit body is imbedded in the tissue of the leaf, extending usually from one epidermis to the other. At maturity the wall of the fruit body bursts irregularly on the under side of the leaf, exposing the grayish-white hymenium beneath. The asci are club-shaped with a constricted, short-pointed apex. The spores are elongate, one- to three-celled, and borne in a fascicle in the end of the ascus.

Arthur,[1] in 1887, described what is probably the same ascogenous form (or closely related species) on plum leaves which were affected with *Cylindrosporium* the previous year. A similar ascogenous fungus was also mentioned and figured on dead leaves of *Prunus* by Pammel[2] in 1892, but in neither case was the fungus named or its connection with the *Cylindrosporium* stage proved.

The question now arises as to what species name should be applied to the perfect stage. One might employ the combination *Coccomyces padi* were it not for the fact that we are confronted with certain difficulties in the use of that name. In the first place we are not certain that the European form on *Prunus padus* is identical with the American form, though there is little doubt that a similar, if not identical, ascigerous stage is present on the dead leaves of that species in Europe. Furthermore, several different names have been used for the prunicolous species of *Cylindrosporium* in North America and a similar difficulty would arise if a choice of one of these were attempted. In the second place, while a specific name already employed for an imperfect stage might be used for a new species there would always arise confusion as to what principle of nomenclature was followed in the combination if a name previously employed for an imperfect stage were used. According to the International code of nomenclature adopted at Brussels in 1910, relating to polymorphic fungi, a species name applied to the perfect stage has precedence over names applied to an imperfect stage. In order, therefore, to avoid any confusion, I propose for the perfect stage of the fungus on *Prunus avium* the name *Coccomyces hiemalis* n. sp. with the following brief diagnosis.

Coccomyces hiemalis n. sp.: *Ascomatibus sparsis* interdum subaggregatis, punctiformis, nigris, ovatis vel orbicularibus, primum claussis, deinde in lacinias plures acutas dehiscentibus; disco pallido carneo, 125–210 μ lat. ascis clavatis, crassiuscule stipitatis, 70–95 $\times$ 11–14 octosporis, apice papillato; paraphysibus filiformibus, simplicibus aut ramosis, apice curvato; sporidiis linearibus 33–45 $\times$ 2, 5–3, 5 μ, simplicibus aut 1–3 septatis.

Hab. In pagina inferiore deiectorum foliorum Pruni avii.

B. B. Higgins
Department of Botany,
Cornell University

[1] Arthur, J. C., "Plum Leaf Fungus," N. Y. Agr. Exp. Sta., Rept. 5, 293–298, 1886.

[2] Pammel, L. H., "Spot Disease of Cherries," Iowa Agr. Exp. Sta., Bull 13, 55–66, 1891.

On the History of Cottons and Cotton Weevils

Referring to my first article on the Peruvian square-weevil,[1] in which were presented data relating to the origin of the cotton plant, it now seems possible to make certain well-founded deductions. The presence of the nearest wild relatives of *Gossypium* only in the New World indicates that the stock from

[1] *Journal of Economic Entomology*, April, 1911.

which these sprang was evolved in Antarctica and spread northward during the Mesozoic after both the African and Austromalaysian connections had been broken. South America was the last of the great land masses to be cut off from Antarctica, hence only in America do we find such nearly related but distinct types as *Ingenhousia* and *Cienfuegosia*. The Australian cottons have been isolated since the southward dispersal of the type which preceded *Gossypium* and which originated in the north. Hence they are found to be farther removed from the Asiatic and American true cottons than are the latter from each other, being properly separated under *Sturtia*. They represent more nearly the immediate type from which *Gossypium* s. str. sprang.

Anthonomus is a type of North American origin, where it was dominant during the Tertiary—Oligocene and Miocene. From some of its first waves of southward dispersal sprang the group to which belongs *Anthonomus vestitus*, which latter has developed on cotton alone in South America. From a later wave of southward dispersal sprang the *A. grandis* group, this species likewise developing on cotton alone, but originating in Central America and Mexico. Almost certainly one of the periodic separations between North and South America took place while the *A. grandis* group dispersal was in progress, thus cutting this species off from South America. During subsequent connections of the two continents no extensive dispersals of these groups occurred. This explains the fact that *A. vestitus* belongs to a group not represented in North America, and indicates the great probability that *A. grandis* does not occur in South America. It also explains the now quite evident fact that both of these weevils have no other food-plant than cotton, having originally developed on that plant.

From these points we may deduce that *A. vestitus* has probably attacked cotton in humid northwestern South America for upward of a million years, if not longer. It is therefore extremely probable that this species is not confined to Peru and Ecuador.

CHARLES H. T. TOWNSEND

THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA

THE fifteenth meeting of this society was held in Cleveland in connection with the American Association for the Advancement of Science, from December 31, 1912, to January 2, 1913. With the exception of the joint session with the American Mathematical Society and Sections A and B of the American Association for the Advancement of Science on Tuesday afternoon, December 31, the meetings were held in the recitation room of the department of astronomy of the Case School of Applied Science. The secretary of Section A has already reported on the joint meeting (see page 76 of this volume).

The time was so thoroughly filled with the program of papers that little opportunity was afforded for attendance of the meetings of the various sections of the association and the other affiliated societies, or for excursions about the city. Most of the members, however, visited the observatory of the Case School, where are housed an excellent almucantar, a zenith telescope and a transit instrument, and accepted the privilege of visiting the Warner & Swazey shops.

The following members were in attendance: Sebastian Albrecht, S. I. Bailey, L. A. Bauer, J. A. Brashear, E. W. Brown, C. A. Chant, W. A. Cogshall, W. S. Eichelberger, Philip Fox, William Gaertner, James Hartness, G. F. Hull, W. J. Humphreys, F. C. Jordan, N. A. Kent, Kurt Laves, T. A. Lawes, W. I. Milham, D. C. Miller, E. W. Morley, E. F. Nichols, J. A. Parkhurst, E. C. Pickering, J. S. Plaskett, W. F. Rigge, H. N. Russell, Frank Schlesinger, H. T. Stetson, R. M. Stewart, J. N. Stockwell, G. D. Swazey, W. R. Warner, F. P. Whitman, D. T. Wilson, H. C. Wilson, Anne S. Young, E. I. Yowell.

Visitors: G. L. Coyle, S. F. Cusick, Patrick Rafferty, J. I. Shannon.

The following were elected members of the society: W. O. Beal, J. R. Collins, Ralph E. DeLury, R. T. A. Innes, William H. Morton, Earl C. Slipher.

Abstracts of the 36 papers which were read follow in the order of presentation.

The Correction of Actinometer Measurements for Aqueous Depletion: FRANK W. VERY.

Tables have been prepared for the approximate correction of actinometric observations with air masses and pressures of aqueous vapor as arguments. The first table of multiplying factors is

for sea level, and the second is for the conditions and altitude (1,780 meters) of Mount Wilson.

TABLE I

Air Mass	Pressure of Aqueous Vapor 1½ mm.	3 mm.	6 mm.	9 mm.	15 mm.
$e=\frac{1}{2}$	$F=1.35$	1.40	1.52	1.63	1.86
1	1.65	1.76	2.02	2.28	2.80
2	2.18	2.35	2.66	2.97	3.60
3	2.60	2.80	3.18	3 53	4.22
4	2.99	3.21	3.58	3.96	4.71
5	3.39	3.66	4.05	4.42	5.15
6	3.69	4.09	4.54	4.88	5.56
7	4.03	4.50	4.97	5.29	5.93
8	4.40	4.91	5.43	5.75	6.25
9	4.74	5.35	5.95	6.22	6.60
10	5.10	5.83	6.43	6.73	6.95

TABLE II

Air Mass	Pressure of Aqueous Vapor 1½ mm.	3 mm.	6 mm.	9 mm.	15 mm.
$e=\frac{1}{2}$	$F=1.70$	1.76	1.78	1.80	1.86
1	2.06	2.16	2.21	2.25	2.30
2	2.34	2.45	2.52	2.58	2.63
3	2.63	2.75	2.84	2.90	2.95
4	2.91	3.05	3.15	3.20	3.25

These tables have been used to get the value ($A=FR$) of the solar radiation outside the atmosphere from observations published in Vol. 2 of the *Annals* of the Smithsonian Astrophysical Observatory. A random selection will illustrate the nature of the results.

TABLE III

Washington, D. C.

Date	Aqueous Vapor, mm.	A	A at Sun's Mean Dist.
Aug. 24, 03	14.66	3.204	3.255
Dec. 23, 03	3.30	2.878	2.770
May 28, 04	6.50	2.855	2.920
Oct. 21, 04	7.29	3.697	3.639
Jan. 9, 06	1.96	3.227	3.106
Mean.....			3.185 ±0.105

Mount Wilson

Date	Aqueous Vapor, mm.	A	A at Sun's Mean Dist.
Oct. 20, 06	1.59	3.602	3.547
June 7, 05	7.17	3.542	3.634
Aug. 22, 05	13.84	3.526	3.585
Mean.....			3.589 ±0.017

The data are very inadequate. The pressure of aqueous vapor is seldom recorded more than once a day, and in the absence of barometer readings I have been obliged to assume values of 760 mm. and 618 mm. for sea level and mountain, respectively. To do full justice to the method, it will be necessary to secure simultaneous observations of the distribution of aqueous vapor in the upper air by means of sounding balloon ascensions or high kite flights. No correction for atmospheric dust has been applied. The depression and the disagreement of the sea-level results are no doubt due principally to the irregular depletion by this ingredient of the lower air. This serious defect very nearly disappears on the mountain.

Astronomy in the Civil Court: W. F. Rigge.

A short time ago a man was accused in the criminal court (Omaha, Nebraska) of having attempted to wreck a cottage and kill its inmates by means of a suitcase full of dynamite. The state produced only two witnesses, who said they had seen the accused carrying the suitcase near the time and place specified. They had just come from a church a mile away, in front of which they had posed for their photograph. The position of a prominent shadow in this picture enabled an astronomer to compute the exact minute of its exposure. As this was half an hour after the time at which the suitcase had been found the testimony of science eventually freed the prisoner from fifteen years in the penitentiary. It was confirmed by the measurements and computations of a second astronomer, and by a series of three photographs exposed at intervals of one minute on the second anniversary of the taking of the original picture.

A Northern Durchmusterung: E. C. Pickering.

The Cape Photographic Durchmusterung gives the positions and photographic magnitudes of nearly half a million stars south of declination −20°, thus covering about one third of the sky. This great work by Gill and Kapteyn is indispensable to any astronomer studying the southern stars.

One of the greatest needs of astronomy at the present time is the extension of this work to the North Pole. A plan has accordingly been prepared for taking the necessary photographs at Harvard, with the 16-inch Metcalf telescope, with curved plates, using those sensitive to the red, as well as to the blue rays. The photometric and photographic magnitudes, on a uniform scale, will be determined for a number of standard stars on

each plate. They will then be sent to Kapteyn, who will supervise their measurement and reduction. If the entire plan can be carried out, the catalogue will contain eight hundred thousand stars, or more, and will fill at least ten volumes of the Harvard *Annals*.

The Scale of the Yerkes Actinometry: J. A. PARKHURST.

A new determination of the absolute scale for the photographic magnitudes of the Actinometry indicates that the published scale may be too extended by an amount not exceeding six per cent. The original scale was obtained from sensitometer images impressed on the plates with exposures of 10 to 20 seconds. The star images had exposures of 5 and 25 minutes. An extended series of new sensitometer exposures ranging from 5 seconds to 34 minutes indicated that the gradation was steeper for the exposures of 5 minutes and longer, than for the exposures in the neighborhood of 10 seconds. No difference was found for exposures of 5 and 25 minutes, and this was confirmed by 422 pairs of images of white stars on the zone plates. The application of the correction of — 6 per cent. brings the magnitudes into better agreement with Harvard and leaves the differences with Göttingen the same in amount but with the sign changed.

The Color Scale of the Yerkes Actinometry: J. A. PARKHURST.

A calibration of the color-sensitive plates used in obtaining the "visual" magnitudes of the Actinometry makes it possible to express the varying effect of light of different wave-lengths in difference of stellar magnitude. The spectral intensity curve is nearly symmetrical and has its maximum at wave-length 5350. The absence of selective absorption in the U-V glass of the Zeiss doublet was shown by comparison of spectra taken direct and through the glass.

On R Lyræ with a Three-prism Slit-spectrograph: SEBASTIAN ALBRECHT.

This paper gave the results of a study of two series of three-prism spectrograms, twenty-five plates in all, taken at the Lick Observatory. Following is a summary of the principal results:

1. The radial velocity of the star is — 27.22 km. per sec.

2. No periodic variation of radial velocity was found. If such a variation exists, the double amplitude of variation must be less than 1½ km.

3. Wave-lengths were determined for about 600 spectrum lines, between λ 4150 and λ 4700 ±.

4. The individual spectrum lines showed no large periodic shifts.

5. H_λ showed definite variation in intensity, though the data available are insufficient to determine definite connection with phase of light-variation.

6. The wave-lengths of the lines in R Lyræ, a star of irregular light variations, are in good agreement with the wave-lengths of lines in the *M* type stars.

7. A preliminary test of this star for spectral type, according to the method published in the *Astrophysical Journal*, March, 1911, places it at a somewhat "later" type than *Mb*, the type assigned to it in the Draper Catalogue.

A New Form of Printing Chronograph: WILLIAM GAERTNER.

This paper described in detail an instrument for recording time in minutes, seconds and hundredths of seconds, printing the records in figures on a strip of paper. The instrument is used in connection with a clock or chronometer fitted with an electric seconds contact, which operates the minute and second type wheels and controls the speed of the 0.01 seconds wheel.

The minute and second wheels are rotated by two specially designed electro-magnets which operate on pawls and ratchet wheels of 60 teeth. The seconds wheel closes a circuit when it has made a full revolution and operates the magnet which shifts the minute wheel. Both wheels can be turned independently by hand and set to coincide with the clock. The wheel printing the 0.01 seconds is automatically set to zero by the clock circuit and control magnet.

The control of the hundredths of seconds is not made directly on the type wheel, but by means of a ratchet wheel of 100 teeth, and an iron pawl engaging in it. The ratchet wheel is driven by a separate weight driven clock work, regulated by an improved form of conical pendulum friction governor. This regulator is set to run a little fast. When it has gained 0.01 second the control magnet operated by the observing clock will disengage the pawl and drop it in the next tooth of the ratchet wheel, bringing the type wheel again in adjustment. In practise the governor is adjusted so that the regulator gains about 1½ second per hour and therefore the control will take place about every 24 seconds.

The printing of the time records is accomplished by an electro-magnet which operates the printing

hammers. A paper strip sufficiently long to take about 1,200 records passes between an ink ribbon and the printing wheels and is fed through two corrugated rollers which give the spacing between records. The same current operates the printing magnet and the electro-magnet which turns the spacing rollers. A mechanism at the same time gives a shift to the ink ribbon.

Samples of the records from the chronograph were exhibited.

Circulation in the Solar Atmosphere as Indicated by Prominences: Frederick Slocum.

This paper is based upon the study of 4,600 solar prominences of which over one third either by their form or movement indicate a horizontal circulation in the solar atmosphere. The results have been classified according to direction N. or S., heliocentric latitude, and height above the chromosphere. Illustrations were shown of the types of prominences used.

The conclusions from this investigation are given in the following summary: (1) Many prominences, by their shapes or movements, seem to indicate the existence of a horizontal current in the solar atmosphere. (2) This current may have opposite directions at different altitudes in the same locality. (3) It may change its direction just as the wind changes upon the earth. (4) In middle latitudes the average tendency for movement is toward the poles. (5) In high latitudes the average tendency for movement is toward the equator. (6) This tendency is much more marked in the northern than in the southern hemisphere. (7) From latitude 10° north to 10° south the average tendency is from north to south directly across the equator. (8) The prevailing directions mentioned above are the same for prominences of all heights. (9) Upon a rotating sphere the circulation is undoubtedly spiral. The observations used in the present investigation take account only of the north and south components. The east and west components may eventually be added by an extended series of radial velocity measures of prominences. (10) Observations upon prominences within 5° to 10° of the poles are unreliable, as a prominence approaching the pole spirally may project so as apparently to be moving away from the pole.

Cosmical Magnetic Fields: L. A. Bauer.

This paper was read at the joint meeting. For the abstract see page 76 of this volume.

(Opportunity is taken here to correct an error appearing in the abstract of Professor Bauer's paper, "On the Cause of the Earth's Magnetic Field," Science, January 3, 1913, page 27. The sentence following the equations should read: These characteristic functions, $f_x(u)$ and $f_z(u)$, show an increase, etc.)

Preliminary Note on an Attempt to Detect the General Magnetic Field of the Sun: G. E. Hale.

Read at the joint session (see page 76 of this volume).

Visualizing the Sun's Way: H. C. Wilson.

Two charts were exhibited showing the proper motions and radial velocities of 1,157 stars. The proper motions were taken from Boss's Preliminary General Catalogue and the radial velocities from unpublished records at the Lick Observatory. Chart No. 1 covers the hemisphere having its center at $\alpha = 270°$, $\delta = +30°$, the approximate apex of the solar motion. Chart No. 2 covers the hemisphere having the solar antapex at its center. Stars having radial velocity of approach to the sun are represented by open circles, while those which are receding are indicated by black circles. The amount of the radial velocity is represented, upon an arbitrary scale, by lines parallel to the lines representing the proper motion. Chart No. 1 indicates quite clearly that the solar apex is somewhere in the vicinity of $\alpha = 270°$, $\delta = +30°$, both by the general trend of the proper motions outward and by the prevalence of open circles near the center of the chart. Chart No. 2 shows equally well that the antapex is near $\alpha = 90°$, $\delta = -30°$, by the prevailing blackness of the star images and the general inward trend of the proper motions.

The Spectra of the Gaseous Nebulæ: Annie J. Cannon.

Of the 140 nebulæ which have been announced to be gaseous, 50 were detected and 54 others have been confirmed from the examination of the Harvard photographs. An examination of 41 of the brightest has been made for the purpose of general classification. While at least three subdivisions of Class *P* of the Draper notation are indicated, it does not seem advisable at present to assign special designations to them.

The principal class is represented by N.G.C. 7662. The so-called chief nebular lines, λ 4959 and λ 5007, are the strongest lines, λ 3726 and λ 3729 in the violet are extremely faint or invisible, while λ 3869 and λ 4686 are well marked. 28 out of the 41 nebulæ so far studied appear to belong to this general class, although 17 differ from N.G.C. 7662 in having λ 4686 absent, and

2 are peculiar in an increased intensity of λ 4363. A broad bright band approximately at λ 4363 was the strongest band in the spectrum of Nova Geminorum, No. 2, on November 9, 1912, and may be characteristic of the spectra of new stars when they become gaseous, as it is also very bright in the photographs of Nova Aræ and Nova Velorum.

A second class of the spectra of gaseous nebulæ has a line in the violet, which is probably a blend of λ 3726 and λ 3729, for the strongest line, while λ 3869 and λ 4686 are absent, and the chief nebular lines λ 4959 and λ 5007 are barely visible. No. 418 of the Index Catalogue, DM. —12°.1172, is the only object so far found belonging to this class. Since λ 3727 and λ 5007 are both present in the spectrum of the Great Nebula of Orion, it may be intermediate between the two classes represented by N.G.C. 7662 and I.C. 418. A third division of gaseous nebulæ has λ 4686 for its strongest line. N.G.C. 40 is typical of this class, and one other $\alpha = 19^h\ 0^m.5$, $\delta = -6°\ 8'$ (1908), similar to it, has been found. This class of nebula is of special interest, owing to a possible connection with the spectra of Class O, in which a bright band at the same approximate wave-length is the distinguishing feature. When an object is faint, it may show only the bright band 4686, and it would then be impossible to determine, from its photographic spectrum, whether it belonged to Class O or to the third division of gaseous nebulæ. N.G.C. 40 was observed by Herschel, and a photographic chart plate shows its nebulous character.

For the purpose of comparison a composite photograph was exhibited showing the spectra of Sirius, of I.C. 418, N.G.C. 7662, Nova Geminorum II., on November 9, 1912, the same on March 13, 1912, H.R. 2583 typical of Class O*b* and N.G.C. 40.

Stellar Spectroscopic Notes: WALTER S. ADAMS.

The following notes contain some of the recent results obtained in the course of the regular radial velocity work with the 60-inch reflector.

The seven stars following are spectroscopic binaries with large range in velocity. *ξ Arietis, Boss 546,* Mag. 5.6, Spectrum B_5. The range shown by the first three plates was 57 km. On a fourth plate two spectra were visible and measures of the separate components gave a relative velocity of 262 km. The spectra of the two stars are nearly identical. *Boss 2484,* Mag. 6.2, Spectrum A_1. The range shown by three plates 88 km. *2 Comæ Berenicis, Boss 3150,* Mag. 6.2, Spectrum A_1. The range shown by three plates 53 km. *Boss 3540,* Mag. 6.8, Spectrum A_0 peculiar. Range shown by three plates 105 km. *16 Sagitarii, Boss 4613,* Mag. 6.2, Spectrum B_1, peculiar. Range shown by three plates 86 km. Traces of a second spectrum are visible. *σ Aquilæ, Boss 5018,* Mag. 5.2, Spectrum B_1. Two spectra are visible on the first plate, one of the type B_5 and the other B_1. The relative velocity of the two components on this plate is 367 km. *Boss 5070,* Mag. 5.8, Spectrum B_5. Range shown by three plates 138 km.

Two photographs of the spectrum of the star *Lalande 15290,* Mag. 8.2, Spectrum G_5, show that its radial velocity is the largest of any star observed to date in the northern sky. The spectrograms which were taken in April and November, 1912, give values of —243 and —241 km., respectively. A photograph of this star taken in December, 1910, with a temporary spectrograph gave an approximate velocity of —250 km. Its proper motion is 1″.97 annually and its parallax is 0″.045 according to the values summarized by Kapteyn in Groningen Publications No. 24. Its velocity in space accordingly as referred to the sun is 318 km., a value only slightly inferior to that of 1830 Groombridge.

Observations of a number of the brighter stars in the *h* and *χ Persei* clusters lead to the interesting conclusion that most of these stars have nearly the same radial velocity and apparently are moving together. The stars observed are as follows:

	Mag.	Spectrum	Mean Velocity
B.D. + 57°.494	6.5	A_1	—44
+ 56°.438	6.5	B_8	—40
+ 56°.470	7.0	B_2	—43
+ 56°.471	6.6	B_1	—43
Boss 519	6.9	B_3	—46
B.D. + 56°.530	6.9	B_8	—45
+ 56°.568	6.7	A_1	—45
+ 55°.612	6.3	B_3	—46

The velocity of *Boss 519* is probably variable. The spectra of most of these stars belong to division *c* of Miss Maury's classification—that is, have relatively sharp lines. The average velocity is exceptionally high for stars of this type and this fact taken in connection with their proper motions and the similarity of their spectra makes it very probable that they form a true group. The star B.D. + 55°.598, Mag. 5.7, has a velocity of —18 km. as determined from one plate and should additional photographs show this velocity to be constant it would seem probable that the

star does not belong to the group. The proper motions of most of these stars have been measured recently by Van Maanen and found to be extremely small and their parallaxes are below the limits of error of measurement according to Kapteyn's results.

A comparison of three photographs of the spectrum of Nova Geminorum II. taken in August, September and November leads to the following conclusions: (1) The principal nebular bands are slightly more intense on the last photograph, while the hydrogen and helium lines remain very nearly constant. (2) A very marked change occurs in the line λ 4687 of the principal series of hydrogen. On the August photograph it is very faint, while in November it is fully half as strong as the intensely bright band λ 4640. This line showed evidence of rapid variation on earlier photographs as well, gaining greatly in intensity between May 5 and May 10. Its behavior should prove of great value as bearing on the physical condition of the star. (3) Two other bands, one at λ 4522 and the other at λ 4605 are considerably stronger on the last photograph. (4) The widths of the bright bands have remained remarkably constant throughout the history of the Nova. Measures on the hydrogen, helium and nebular bands show no appreciable change from the photographs of April and May. The positions of the centers of the bands also remain as on earlier photographs, being displaced from one to two Ångstroms toward longer wave-lengths. (5) All of the more prominent bright bands except those at λ 4522, λ 4605 and λ 4640 have broad faint absorption bands nearly symmetrically placed upon them. In several cases the dark bands contain one or more narrow absorption lines. A remarkable case of this sort is the line at λ 4337.5 which has been measured upon all of the photographs taken since March. The bright bands are terminated on either side by bright maxima, the violet member of which is the strongest on the plates of August and November. (6) In addition to the bright bands the spectrum of the star almost certainly shows an extremely faint continuous spectrum probably crossed by dark lines. The *H* line of calcium is seen as a dark line on the November photograph and yields a value of the radial velocity of about + 5 km.

From these considerations it is evident that the spectrum of this Nova and probably of other Novæ as well is by no means so simple in its later history as has sometimes been supposed. The great width of the emission bands, the presence of well-defined selective absorption within them, the persistence of the displacement of their centers toward longer wave-lengths, as well as the marked variation in intensity of some of the important bands such as λ 4687, all go to show that the physical conditions present are the most complex, and must differ greatly from such as produce an ordinary nebular spectrum.

Rate of Light Changes in Various Celestial Objects: S. I. Bailey.

A discussion of the variable stars in Messier 3 shows some examples of extraordinary rates of increase in light. This globular cluster is a faint hazy star of about the sixth magnitude to the naked eye. Its marvelous character is not suggested even in a small telescope. At Arequipa with an exposure of 100 minutes with the 13-inch Boyden Refractor about 1,200 stars were shown. These plates showed stars somewhat fainter than the 16th magnitude. Among these were found 137 variables among 900 stars actually examined for variability, or one in seven. The total number of stars in the cluster is very great. On a plate made by Ritchey on Mt. Wilson with the 60-inch reflector giving an exposure of four hours not less than 30,000 stars are seen, if we include the central mass where an exact count is impossible. Among the variables found in this cluster the maximum rate of increase in four cases appears to be more than six magnitudes an hour. The mean maximum rate of increase of all the variables is about two and a half magnitudes an hour.

It is doubtful whether any other celestial object has so great a known rate of variation as six magnitudes an hour, although it seems probable that this rate may be exceeded in the case of Novæ. Except for Novæ great rates of change appear to be rare. χ *Cygni* has a range of nearly ten magnitudes, but this enormous change takes place during so long a time that the rate per hour is only a fraction of a magnitude. Eros has perhaps the shortest period of a known object. From one maximum to the following is only about two and a half hours. The range may be a magnitude or more at times, and the light curve closely resembles a sine curve. Its maximum rate of change is probably never more than two or three magnitudes per hour. Some of the Algol variables change very rapidly. *U Cephei* and *W Delphini* are good examples. The rate per hour, however, of any known Algol star does not exceed two or three magnitudes per hour.

Relative Intensity of Prismatic and Grating Spectra: J. S. PLASKETT.

The grating spectrograph used was briefly described at the last meeting and is arranged to be used in the Littrow form, giving linear dispersion 17.5 Å per mm. and with incident and diffracted pencils 30° apart giving 33.0 Å per mm. A half prism silvered on the back can be substituted for the grating in the Littrow form, giving the same dispersion at H_γ. Comparisons of intensity were made with the Ottawa three-prism and one-prism spectrographs, giving practically the same dispersions at H_γ. Spectra of the sun and of different stars agree well in showing: (1) The grating does not diffract more than 30 per cent. of the incident light and the spectra are correspondingly weak. (2) The diffraction star spectra are practically uniform in intensity between λ 4800 and λ 3850. (3) Prismatic spectra are relatively stronger in the blue and weaker in the violet than diffraction spectra. (4) Diffraction spectra become equal in intensity to the three-prism spectra at λ 4250, to one and to half-prism spectra at λ 3970. Above these regions prismatic are stronger, below weaker than diffraction spectra. (5) The great loss of light by absorption in prisms is shown by comparison of one- and three-prism spectra. The former are more than twice as strong between H_β and H_γ, three times at λ 4250, seven times at λ 4150, fifteen at H_δ.

A diffraction star spectrograph would be of value in the ultra-violet, when spectra of uniform intensity from H_β down were required, and in the red end where prismatic spectra are unduly compressed.

A New Form of Clock Synchronization: R. MELDRUM STEWART.

The form of synchronization described is adapted to the case where both the synchronized and the synchronizing clocks control electric circuits. In the particular case where it is applied at the Dominion Observatory the synchronizing clock controls a circuit which is closed every alternate second, while that controlled by the synchronized clock is closed for one second every minute, for the purpose of operating electric "minute jumpers." Each of these circuits operates a relay, and it is the coincidence of the opening of the relays which forms the automatic test of synchronism, which takes place every minute. In addition there is used a neutrally adjusted polar relay; the circuit from a local battery is so arranged that, once a minute, while the relay operated by the controlled clock is closed, current flows through the winding of the polar relay, the direction of the current depending on the position of the armature of the relay operated by the synchronizing clock. Thus, at the instant of the opening of the relay operated by the controlled clock, the position of the armature of the polar relay depends on whether the "synchronizing" relay is open or closed (that is, on whether the controlled clock is slow or fast); and since the polar relay is neutrally adjusted, it will remain in the same position until current next flows through it, *i. e.*, until the next even minute. As soon as the relay operated by the controlled clock has opened, its back contact is utilized, in series with the points of the polar relay, to send a current through one or other of two magnets in the clock case, and so to either add to or remove from the pendulum a small weight, so as to accelerate or retard the clock for the following minute. At the end of the minute the automatic comparison is again made, and the clock again accelerated or retarded as required.

The controlled clocks are not particularly good timekeepers, and are exposed to considerable vicissitudes of temperature; to ensure satisfaction the correcting weights are made capable of taking care of a variation in rate of 8 or 10 seconds per day; the synchronization is in this case effective to within about a hundredth of a second. In the case of a high-grade clock very much smaller correcting weights could be used, and the interval between the automatic comparisons could be increased to perhaps an hour.

The principal advantage of this type of synchronization is that there is no possibility of stopping the controlled clock by interference with the synchronizing current, an advantage which, so far as I am aware, is not shared by any other method.

An Investigation of the 9.4-inch Photographic Objective of the Shattuck Observatory: H. T. STETSON.

The original 9.4-inch visual lens by Alvan Clark has been made convertible into a photographic by the substitution of a new flint, giving a focal length of 10 feet 6 inches. Measurements of extra focal plates taken after Hartmann's method for determining aberration errors show extreme variation in the focus to be less than one part in 3,000 for the same wave-length. The greatest irregularities lie in zones of 55 cm. and 85 cm. radii, where

there is marked shortening of the focus. Computation of the "criterion" constant gives $T = 0.33$, placing the quality well within the highest class.

The mean diameter of the confusion disk, when expressed in seconds of arc, becomes 0″.69 as against 0″.45 for the 40-inch Yerkes. The theoretical resolving power of a 9.4-inch is 0″.52, whereas for the 40-inch it is 0″.12. It is suggested that a criterion to best represent the quality of the optical work should involve this constant for any given aperture. This would appear to favor the quality of the smaller lens. This ratio might well be called a "coefficient of resolution."

On the Luminous Efficiency and Color-index of a Black Body at Different Temperatures: Henry Norris Russell.

The curves of spectral sensitiveness given by Parkhurst in his "Yerkes Actinometry" (with the addition of certain data very kindly communicated by Professor Parkhurst) make it possible to compute the luminous efficiency of a body radiating according to Planck's law at any temperature, that is, the ratio of its actual visual or photographic brightness to that of a body radiating the same amount of energy, but all of the wave-length of greatest visual or photographic efficiency. The results here given are provisional, and may be somewhat altered when fuller data regarding the spectral sensitiveness become available.

The visual luminous efficiency is a maximum for a temperature of about 7,500°, its value being 0.11. The visual surface brightness, on the Yerkes scale, varies with the temperature very nearly as the intensity of monochromatic radiation of wave-length 0.541 μ, and the photographic surface brightness like that of wave-length 0.428 μ, the deviations averaging less than $0^m.07$ for temperatures between 2,000° and 25,000°. The color-index can be still more closely represented by the formula

$$\text{Phot.} - \text{Vis.} = \frac{7500^\circ}{T} - 0^m.70,$$

the residuals averaging only $0^m.02$.

For the Harvard visual and photographic observations the mean effective wave-lengths appear to be 0.516 μ and 0.419 μ, and the color-index is given by the equation

$$\text{Phot.} - \text{Vis.} = \frac{6900^\circ}{T} - 0^m.60.$$

The "black-body" temperatures corresponding to the color indices of stars of the various spectral types may now be determined. The Harvard and Yerkes data give effective temperatures (ranging from 23,000° for Class B_0 to 3,100° for Class *M* and 2,300° for Class *N*), which are in excellent agreement with one another and with the previous determinations of Wilsing and Scheiner by visual spectro-photometric methods.

It appears also that the relative visual surface brightness of any two "black bodies" at different temperatures, if expressed in stellar magnitudes, should be 3.8 times the relative color-index on the Yerkes scale, or 4.3 times the color-index on the Harvard scale. The luminous efficiency is almost constant for color-indices between 0.0 (Sp. *A*) and 0.7 (Sp. *G*), but falls off rapidly for bodies at lower temperatures.

If these results, which are strictly true only for theoretically perfect radiators, apply approximately to the actual stars, and we could measure the brightness of the latter by means of their whole energy radiation, instead of a narrow spectral region, stars of Class *K* would seem about twice as bright, those of Class *M* four times as bright and of Class *N* more than twenty times as bright as they do now, in comparison with stars of Classes *A* to *G*. This would profoundly modify our estimates of the relative abundance of stars of different spectral types.

The Eclipsing Binary ε Aurigæ: Harlow Shapley.

More than five thousand observations of the variable star *ε Aurigæ*, made by Schmidt throughout the interval from 1843 to 1884, have been studied by Ludendorff, who deduces a period of light variation of 27.1 years and a light curve similar to those of certain eclipsing variables. Only three minima have occurred since the discovery of the light fluctuation by Fritsch in 1821. A study of the light curve by the writer shows that the observations can be satisfactorily represented by the eclipse theory. An accurate orbit is not possible, notwithstanding the large number of observations, but limiting sets of elements have been derived. The eclipse is total—the small bright star being completely hidden for more than a year behind the faint companion, whose volume is one thousand times the greater. The component stars are distantly separated. The mean density of the smaller component, if the masses are approximately equal, is not unusual in comparison to the densities already found for *W Crucis* and *RZ Ophiuchi*, whose periods of 198 and 262 days, respectively, are the longest heretofore known. The density of the big com-

panion, however, is about one millionth that of the atmosphere at the earth's surface. This greatly surpasses the rarity of any other known eclipsing star, but even then must be considered stellar rather than nebular. The sun extended to Jupiter's orbit would not be so dense as this, and seen from a neighboring star would certainly appear as a stellar point. Except near the limb, the larger component will be perfectly opaque. Through the center of the star the extinction must be nearly 40 magnitudes, if the mass is taken equal to the sun's mass. To allow for the translucence near the beginning and end of eclipse, the relative radii of the stars must be reduced still further, which would tend to make the density of the smaller star entirely normal without materially diminishing the density of the large component. The elements of the best orbit, which allowed for darkening to zero at the limb, are as follows: ratio of stellar radii, 0.10; inclination, 77°.0; radius of large star (distance of centers, unity), 0.307; light of each component, 0.50; relative surface brightness, 0.01; hypothetical secondary minimum, $0^m.004$; "equal-mass" densities, 2.4×10^{-9} and 2.4×10^{-6}.

Harvard classes the spectrum as F_3p. Ludendorff finds peculiarities in the radial velocity, and is making a detailed spectroscopic study of the system.

Film Distortions on Small Photographic Plates: F. E. ROSS.

By means of a reseau, tests were made of the film distortions on the small photographic plates used in the photographic zenith tube at Gaithersburg, Md.

The cut Lumiere Sigma plates are 37 mm. long by 27 mm. wide.; in all forty plates were measured, of which 20 were dried in air in the usual way, and 20 were immersed in alcohol before drying. Distortions in only one coordinate, the plates' length, were measured. The air-dried plates showed large, irregular distortions. The probable error of a measured 2 mm. space was $\pm 1.5\,\mu$; of a 22 mm. space, $9.6\,\mu$. For larger distances the probable error was somewhat smaller. The corresponding probable errors of alcohol-dried plates were $0.7\,\mu$ and $2.7\,\mu$, respectively. The probable error of an average distance on air-dried plates was $6.5\,\mu$; on alcohol-dried plates $1.4\,\mu$.

The maximum distortion observed on an air-dried plate was $49\,\mu$; on an alcohol-dried plate $10\,\mu$.

Air-dried plates always showed an expansion over about three fourths its distance from the center. At this point the expansion, which amounted to $19\,\mu$, ceased, but the irregularities became a maximum.

No certain expansion of the alcohol-dried plates could be detected. Air-dried plates which showed unusually large distortions were resoaked in water, dried in air and remeasured. The distortions were found to have been notably changed, in both distribution and amount. They were again well soaked and measured while wet. The distortions were found to have disappeared. Other air-dried plates showing large distortions were resoaked and redried in alcohol. The distortions disappeared in this case also.

Some Effects of Radiation upon Astronomical Instruments: F. E. ROSS.

Read, but no abstract was submitted.

Recent Progress in the Theory of the Galilean Satellites of Jupiter: KURT LAVES.

The paper is a part of a report concerning the Theory of Satellites in the Solar System, which will appear in Vol. VI. of the "Encyclopaedie der Math. Wissenschaften," published by the Academy of Sciences of Göttingen.

The modern investigations of de Sitter, Cookson, Sampson and others were considered, and attention was drawn to the fact that the old Laplace-Souillard theory is inadequate from a modern standpoint.

The Solar Rotation in 1912: J. S. PLASKETT.

Two series of rotation plates were obtained in 1912, though with great difficulty, owing to cloudy and hazy weather. The first of these series, center at λ 5600, the special region allotted to Ottawa, was obtained during June, and the second, center at λ 4250, the general region, during October. The first series, consisting of 25 spectra at each of the latitudes 0°, 15°, 30°, 45°, 60°, 75°, 80°, 85°, was measured and reduced by the writer, and the velocity values obtained are well expressed by a formula of the Faye type.

$$V = (1.431 + 0.563 \cos^2 \phi) \cos \phi,$$

where V is the linear velocity in kilometers per second and ϕ the heliographic latitude. The coefficients of this formula lie between those of the two series obtained in 1911 and the observed values for the two years are in good agreement, the only differences of any magnitude being at latitudes 45° and 75°, where the 1912 value is about 0.04 km. per second lower. The measurement and reduction of the other series will likely give defi-

nite information as to the best value of the coefficients of the formula and as to the discrepancy at the two latitudes.

Orbital Planes of Binaries: John M. Poor.

The paper gave a preliminary statement in regard to a statistical method of investigating the parallelism of orbital planes of binary stars to any particular plane in space.

The several attacks upon the problem of determining whether the orbital planes of binary stars are parallel to any particular plane in space have led to no very positive indications that such parallelism exists in the case of the best determined orbits of binary stars.

If such parallelism exists it ought to be indicated in a statistical study of measures of binary stars by the systematic variation in magnitude for different parts of the sky of the correlation coefficient expressing the relation between position angle and distance of the doubles in a limited area of the celestial sphere. As this problem is more easily solved in rectangular than in polar coordinates, it may be put in the form of finding the correlation between $s \cdot \sin P (= x)$ and $s \cdot \cos P (= y)$.

With a view to making a study of this question along these lines the necessary computations have been begun at the Shattuck Observatory, though a sufficient number of correlation surfaces has not yet been computed to allow conclusions to be drawn.

It is hoped that double star observers to whose attention this preliminary statement may come will cooperate by furnishing the writer with lists of their observations published since the appearance of Burnham's General Catalogue in order that the final computations may be based on as large an amount of material as possible.

On Climatic Changes and the Cause of Ice Ages: W. J. Humphreys.

Numerous geological records give evidence of great climatic changes in the past, culminating at times in excessive heat and aridity and at other times in extreme cold and corresponding precipitation. It appears too that the great climatic changes were simultaneous and in the same sense the world over—warmer everywhere or colder everywhere. Hence, whatever the chief cause of these effects, it must have been world-wide.

Certain variations of long duration in the energy output of the sun would meet the above conditions, but the cause of such variations is not apparent nor is there other evidence that they ever actually took place. Hence it seems well to seek for some general terrestrial cause of climatic change—for something in or of the atmosphere.

More or less continuous pyrheliometric records since 1880 show marked deficiencies in the amount of solar radiation received at the surface of the earth during the years 1884, 1885, 1886, 1903 and since June, 1912. The first of these periods followed the explosion of Krakatoa, the second the explosion of Mount Pelée and the third that of Katmai in Alaska. The only other minimum of importance, about half as great as those just mentioned, occurred in 1891 and presumably was also connected with a volcanic explosion.

Now the fine volcanic dust, roughly one micron in diameter, when thrown into the isothermal region of the atmosphere must settle slowly, since it is above the reach of clouds, and spread over all parts of the earth, as we know it did after each of the above-mentioned volcanic explosions. Further, the fine dust *scatters* the short wave-length solar radiation to a much greater extent than it does the relatively long wave-length earth radiation. In other words, earth radiation gets out through this enveloping layer of dust much better than solar radiation can get in. Hence the final equilibrium temperature of the earth as a whole, other things being equal, necessarily is lowered by the presence of a dust veil in the upper atmosphere. In the cases cited above the decrease of insolation seemed sufficient, if long continued, even to bring on an "ice age."

During the geological past there have been several periods of great volcanic activity with intervening ages of volcanic quiescence, just as there have also been ages that were warm and dry alternating with others that were cold and wet.

From the above considerations it is suggested that the alternate presence and absence, each for long periods, of volcanic dust in the high atmosphere may have been an important if not even the controlling factor in bringing about the great climatic changes of which geological records furnish abundant proof.

Photographic Magnitudes of the Brighter Stars of the Polar Sequence: Frederick H. Seares.

The investigation of the magnitude scale of the Polar Sequence previously reported has been extended by photographing the brighter stars with diaphragms and screens producing apparent magnitudes between 10.5 and 15.5. The actual magnitudes were found by comparison with the fainter stars for which the scale had previously been

established. The results for any given diaphragm or screen establish a scale for the bright stars which should be homogeneous with the adopted scale for the faint stars, and, as far as the slope is concerned, independent of the reduction constant of the diaphragm. With one exception, the results for all the diaphragms and screens used are in substantial agreement, and show a mean divergence between Mt. Wilson and Harvard expressed by

$$\text{Mt. W.} - \text{H.} = +0^{m}.33 + 0^{m}.075(M - 10.5).$$

The formula holds between magnitudes 2 and 10.5. From 10.5 to 15.5 the scales are parallel, with the constant difference $+0^{m}.33$. The Mt. Wilson results agree closely with those of Parkhurst and Schwarzschild, which extend from magnitude 4.0 to 7.5.

The Photographic and Visual Light-curves of RR Draconis: FREDERICK H. SEARES.

At the fourteenth meeting of the society an announcement was made concerning the photographic variation of the Algol star *RR Draconis*. The eclipse is necessarily that of a bright object by a larger and fainter companion. The relative amounts of light are approximately as 32 to 1, and probably the larger object is the redder of the two. The photographic variation should therefore exceed the visual. This hypothesis was tested by photographing the star upon ordinary and isochromatic plates, the latter being used in connection with a yellow filter. The photographic and photovisual magnitudes of the comparison stars were determined by the use of diaphragms, the zero points of both scales being fixed by comparisons with the Harvard Polar Sequence. The greater photographic range is clearly shown. The results are

	Photographic	Photovisual	Color-Index
Maximum	9.64	9.98	— 0.34
Minimum	13.46	13.23	+ 0.23
Amplitude	3.82	3.25	0.57

The epochs of photographic and photovisual minima are probably the same. The maximum difference permitted by the present series of measures is 0.002 day, the photovisual minimum following the photographic.

Some Recent Changes in the Spectrum of Nova Geminorum No. 2: R. H. CURTISS.

On December 4, 1912, Nova Geminorum No. 2 was found to be passing through a period of marked light recovery. Its brightness, 7.5 magnitude, was identical with its former value seven months previous or about eight weeks after discovery. During two weeks following December 8 the Nova faded rapidly down to magnitude 8.3. Visually the Nova was of a decided greenish-blue color during this period. The spectrum, however, underwent some marked changes.

At the brighter phase of the Nova's recovery the hydrogen lines and $\lambda 4635$ had developed greatly in strength and intensity, but with declining light the nebular lines had become the strongest feature of the spectrum. Our observations indicate that the nebular lines actually gained in brightness or at least held their own while the total light of the star waned, but during the same interval the hydrogen lines faded rapidly.

Radial velocities from the dark H line of calcium agree with the value of ten kilometers per sec. positive, obtained shortly after the Nova's discovery.

Do the Declinations of the Accepted Fundamental Catalogues Represent the True Positions of the Stars? W. S. EICHELBERGER.

From two papers presented at the Ottawa meeting by F. B. Littell, on the work of the 6-inch transit circle, and on the work of the altazimuth at the Naval Observatory it appears that the declinations of the stars in Boss's General Catalogue culminating south of the Washington zenith require a correction of about $+0''.5$.

This result is confirmed by the results in the volume of the Greenwich Observations for 1908, and the results obtained with the 9-inch transit circle of the Naval Observatory. Further, the 9-inch results show a practically constant correction from declination $-30°$ to declination $+45°$, a rapid but nearly uniform decrease in the size of the correction from declination $+45°$ to declination $+60°$ and a nearly zero correction from that point to the pole. The rapidly changing correction a few degrees north of the zenith with a constant correction through the same zenith-distances south of the zenith would indicate that the fault can hardly be in the instrument. Can it be in the declinations of the fundamental catalogue?

If there is a discontinuity at the zenith in the determination of declinations at the various European observatories due either to the instrument or to the observer, such an error as supposed may have been introduced into the fundamental catalogues.

The following table, giving the differences between the declinations of three pairs of Pulkowa and Greenwich Catalogues, shows that such a discontinuity exists at least in some of the catalogues.

Decl.	No. Stars	$P_{45}-G_{45}$	Decl.	No. Stars	$P_{65}-G_{72}$	Decl.	No. Stars	$P_{85}-G_{80}$
71° to 65°	10	−0.″03	72° to 65°	15	−0.″08	72° to 63°	16	+0.″15
65° to 61°	8	−0.13	64 to 60	10	−0.10	63 to 60	10	+0.24
Pulk. Zen.								
60° to 55°	13	+0.03	60 to 55	14	−0.63	60 to 56	12	+0.20
55° to 51°.5	6	−0.11	55 to 51.5	11	−0.62	56 to 51.5	13	+0.16
Green. Zen.								
51°.5 to 45°	19	−0.46	51.5 to 46	13	−0.79	50 to 45	18	+0.06
45° to 40°	15	−0.44	46 to 41	14	−0.99	45 to 40	18	−0.07
			41 to 35	14	−0.81			

A discontinuity at the zenith of about 0″.5 is indicated in the Pulkowa Catalogue of 1865, and another of about 0″.4 in the Greenwich Catalogue of 1845.

About half the circumpolars at Pulkowa culminate south of the zenith at their upper transit, and these should give a different latitude from those that culminate north of the zenith at their upper transit, if there is a discontinuity at the zenith. Therefore all the circumpolar observations of the above-mentioned Pulkowa Catalogues were rediscussed to obtain new corrections to the adopted latitude and refraction, introducing into the equations of condition a term (z) to allow for the discontinuity at the zenith.

In the 1845 catalogue all the 110 circumpolars were included in the discussion instead of restricting oneself to the 43 used for a similar purpose in the introduction of that catalogue, and in the 1865 catalogue all of Gyldén's zenith distances were increased 0″.15 to correct for the relative personal equation of Gyldén and Nyrén.

The results of this rediscussion of the Pulkowa observations are as follows:

Z (Decl. south of zenith relatively too small)

1845	+ 0″.09	± 0″.14
1865	+ 0″.37	± 0″.10
1885	+ 0″.12	± 0″.08

	Refraction Constant		Refraction Constant of Catalogue
1845	57″.47	± 0″.064	57″.56
1865	57″.45	± 0″.045	57″.56
1885	57″.38	± 0″.035	57″.37

	Latitude		Latitude of Catalogue
1845	59° 46′	18″.75 ± 0″.10	18″.67
1865		18″.67 ± 0″.07	18″.54
1885		18″.55 ± 0″.06	18″.54

These values of the constants of reduction give the following corrections to the published declinations:

Decl.	1845	1865	1885
50°	+0.″14	+0.″33	+0.″07
25	+0.20	+0.38	+0.07
0	+0.29	+0.50	+0.06
−25	+1.13	+1.54	−0.03

Orbit of the Spectroscopic Binary π^5 Orionis: Oliver J. Lee.

The variable velocity of the star π^5 *Orionis* was announced by Frost and Adams with measures of seven three-prism plates in the *Astrophysical Journal*, 17: 151, 1903.

The following elements have been derived from these measures and from the writer's measures on fifty-seven one-prism plates taken with the Bruce spectrograph in the interval 1907–12:

Period	3.70045 days
Eccentricity	0.051
Longitude of periastron	84°
Semi-amplitude of oscillation .	58.6 km.
Velocity of system	+ 23.7 km.
$a \sin i$	2,978,000 km.
Time of periastron passage ..	1907 Dec. 8.83
	or J.D. 2,417,918.83

The Expression of Pivot Errors by a Formula: R. Meldrum Stewart.

Even the best measurements of pivot errors of a meridian circle or transit instrument are of course affected by accidental errors, and in the case of fairly good pivots these are no doubt larger than the actual deviations of the pivots from a smooth curve. It then becomes a question what pivot corrections should be adopted both for the positions in which the errors have been observed and for intermediate positions. In a recent series of measurements at the Dominion Observatory it was found that a good representation could be obtained by the use of a Fourier series, and it seems probable that the values so adopted are more accurate than the actual observed values.

It is evident that a Fourier series can be made to represent the observed values to any required

degree of accuracy; for example, the use of 72 unknowns would reproduce the observed values exactly, in the case where the intervals are 5°. Since, however, these observed values contain errors of measurement, it is probable that a more exact representation of the actual errors will be obtained by omitting the terms with small coefficients; if this be granted, the number of terms to be retained may in any particular case be decided by a computation of the probable error of a single observation. As several independent measurements of the pivot errors are usually made in a series, the probable error of a single observation may be computed directly from the residuals; if now we have a formula which is assumed to represent the actual pivot errors, the differences between the observed values and those computed from the formula may be used to form another probable error; the relative magnitude of these two probable errors will furnish a criterion as to the number of terms required in the formula. The freedom of the residuals from any systematic tendency will of course furnish the final test as to whether or not the formula is suitable.

In the actual determination referred to, which was made by the microscopic method, eight complete measurements were made; the probable error of a pair of microscope pointings (treated as a single observation) was found to be 0.0015 sec.; four terms of the Fourier expansion were found to be sufficient to reduce the computed probable error to the same value, and the resulting formula was adopted as definitive. This formula, expressing the necessary corrections to the observed collimation, was

$$\begin{aligned}\Delta c = {} & 0^s.0010 \cos (2\theta - 188^\circ\ 29') \\ & + 0^s.0117 \cos (3\theta - 3^\circ\ 17') \\ & + 0^s.0021 \cos (4\theta - 59^\circ\ 45') \\ & + 0^s.0008 \cos (5\theta - 121^\circ\ 58'),\end{aligned}$$

θ being the zenith distance. The residuals from the formula were satisfactorily small (in no case exceeding 0.002 sec.) and appeared to be purely accidental.

Values of the formula were computed for different zenith distances, and from these a table was prepared giving the zenith distances at which the value of Δc changed from one unit (in terms of 0.001 sec.) to the next; it is this table which is used in the reduction of transits.

The Variable RV Capricorni: S. D. TOWNLEY.

The variability of *RV Capricorni* was discovered by Götz in 1905. From fourteen photographic observations scattered over an interval of five years he deduced a light curve of the Algol type. Seares and Haynes observed the star in 1906 and found a light variation of the antalgol type, with an approximate period of $10^h\ 44^m.6$. The star is classed as an antalgol by Hartwig, and Seares's epoch and period are used in computing the ephemeris.

During the summer and fall just past *RV Capricorni* was one of a list of variables observed by the writer with the 12-inch refractor and Rumford photometer of the Lick Observatory, the use of which was kindly granted by Director Campbell. Three well-determined maxima were obtained and these show that the Seares ephemeris now needs a correction of about $3^h\ 10^m$—the observed maxima coming that much before the computed.

By comparing a well-determined maximum obtained on October 11, 1912, with the first one obtained by Seares, August 13, 1906, a period of $0^d.447573$ has been derived, while the period determined by Seares is $0^d.4476$, which is therefore correct to the number of decimals given.

The observations show conclusively that this star is not of the Algol type, but there is perhaps some question as to whether it belongs to the antalgol or to the cluster type. Additional observations near minimum brightness, which I hope to obtain next summer, will be necessary to decide this point.

Notes on the Real Brightness of Variable Stars: HENRY NORRIS RUSSELL.

The number of variables and of stars having peculiar spectra contained in Boss's Preliminary General Catalogue is large enough to enable an approximate estimate of their mean distance and real brightness to be made by the method of parallactic motion. Assuming that the sun is moving towards 18 h., + 30° at 19 km. per second, the following values have been found, in the usual way, from the data of Boss and Campbell, for the parallactic motion M, the mean proper-motion τ at right angles to the parallactic motion, the mean parallax π, the mean peculiar velocity—τ km. at right angles to the line of sight and the solar motion, and ρ in the line of sight, and finally the absolute magnitudes corresponding to the mean observed magnitude and mean parallax. Data for three groups of stars selected at random from Campbell's list of stars of Class B are added to test the value of the method for small groups, and some of the results of Campbell for large numbers of stars are added for comparison.

Objects	No.	Magnitude		M	τ	π	τ km., km.	ρ km.	Abs. Max.	Mag. Min.
		Max.	Min.							
Cepheid variables	13	4.3	5.1	0".015	0".007	0".004	8	9	−2.8	−2.0
Long-period variables	12	4.5	9.4	0.048	0.073	0.012	28		−0.1	+4.8
Irregular variables (Spectrum M)	11	3.7	4.9	0.060	0.042	0.015	13		−0.4	+0.8
Stars of Sp. O to O_{e5}	24	4.95		0.016	0.006	0.004	7		−2.0	
Stars whose spectrum shows bright hydrogen lines	50	4.53		0.028	0.009	0.007	6		−1.3	
Random groups of stars of spectra B to B_5.	12	3.9		0.024	0.009	0.006	7	5	−2.2	
	11	3.7		0.036	0.007	0.009	4	6	−1.5	
	11	3.7		0.043	0.011	0.010	5	6	−1.3	

Campbell's Results

Spectrum B	180	4.07	0.008	0.006	6.2 −2.1
F	180	(4.3)	0.108	0.035	14.4 (+2.0)
G	118	(4.3)	0.075	0.022	15.9 (+1.0)
M	71	(4.3)	0.038	0.011	17.1 (−0.5)

The variable stars of spectrum M appear to be much like the general run of stars of this spectral class in distance, peculiar velocity and (at maximum) in brightness, being then about 100 times as bright as the sun. At minimum, the average long-period variable seems to be comparable with the sun in brightness.

Stars of Class B, showing bright hydrogen lines, do not differ materially in distance, brightness or peculiar velocity from those that do not, and stars of spectrum O are but little farther away or brighter.

The Cepheid variables, on the contrary, are very much farther away, brighter and more slowly moving than most stars of Classes F or G, and closely resemble the Orion stars in all these respects, and also in their strong condensation toward the Milky Way—so much so as to suggest some real relation between them. Even at minimum, these stars average some 400 times as bright as the sun. If they are comparable with it in surface brightness, as seems very probable, their diameters must be at least ten times the sun's—far larger than their spectroscopic orbits. If their average density was less than 1/1200 that of the sun, their companions would collide with them at periastron. It follows that the larger components of these systems must be more massive than the sun, and the invisible companions of the order of one tenth the mass of their primaries—as Campbell has anticipated.

The great brightness of all these variable stars seems a very serious objection to any theory which represents them as stars nearing extinction, but unfortunately, does not itself suggest any theory of their nature.

The Jupiter Perturbations of the Group of Small Planets, $\mu = 2/5$: D. T. Wilson.

Tables have been constructed by the Hansen-Bohlin method for the computation of the perturbations of Jupiter on the group of small planets whose mean daily motions are in the neighborhood of 750″. The perturbations of Pandora 55, of Bellona 28 and of Johanna 127 have been computed and the results compared with those of the same planets computed by Hansen's method by Messrs. Möller, Bohlin and Olsson.

Correcting and Testing Micrometer Screws: Wm. Gaertner.

Read by title.

The Temperature assigned by Langley to the Moon: Frank W. Very.

Langley's opinions in regard to the temperature of the lunar surface in sunshine varied widely at different times, but in the main he favored a low temperature.

The foundation of this opinion is examined and is shown to be invalid. Incidentally, statements by other investigators, which are based to some extent on Langley's opinion, are discussed.

The paper will be published in Science.

At the end of the last session a resolution was adopted expressing the thanks of the society to the authorities of Case School and other friends in Cleveland for the hospitality and privileges extended to the members of the Society.

Philip Fox,
Secretary